# The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

June 1944

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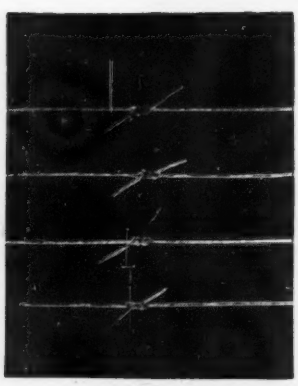

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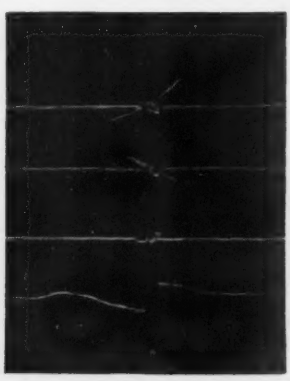

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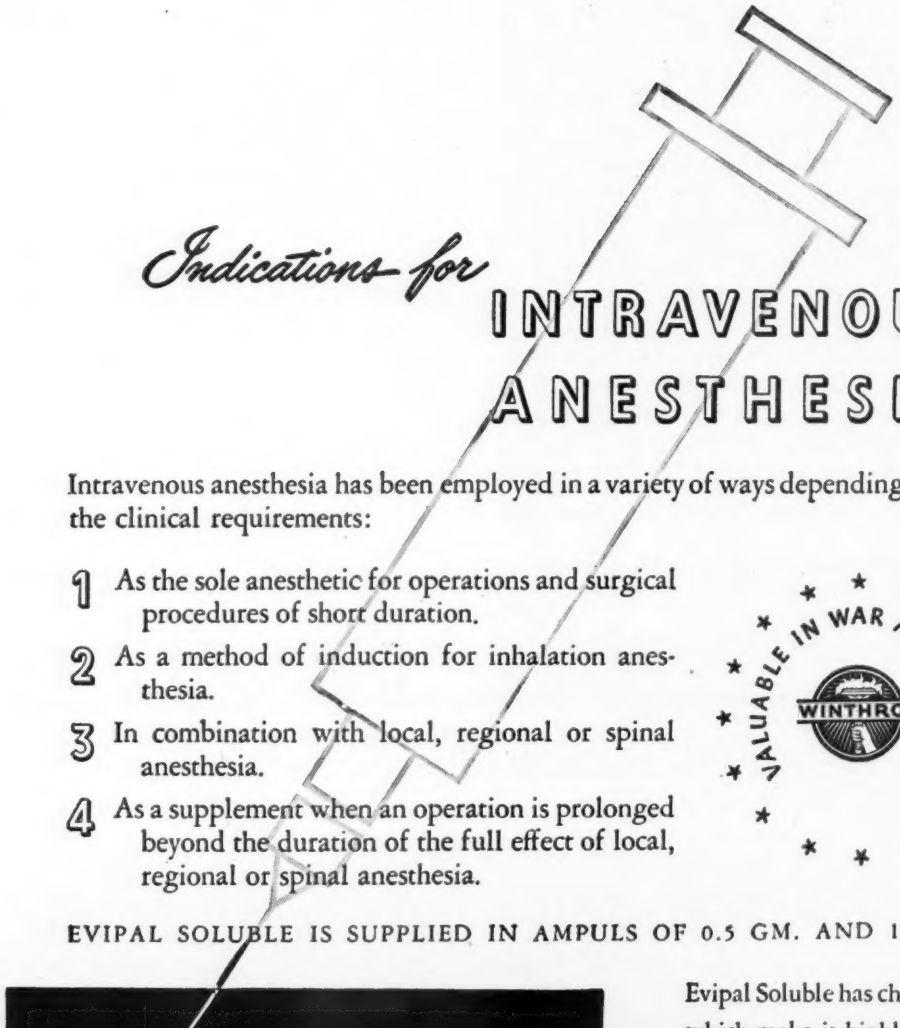

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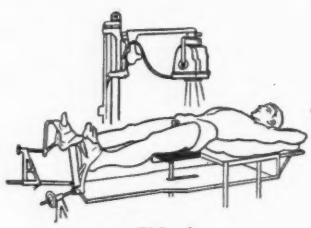

FIG. I

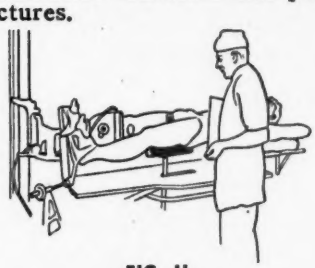

FIG. II

**Fig. I**—*The anterior tube is centered over the lateral aspect of the shaft, one inch distal to the greater trochanter.*
**Fig. II**—*Tube shifted from anterior to lateral position with center of tube in line with lateral x-ray director without moving either legs or disturbing drapes. Cassette Holder is placed in pillow case and held very snugly above crest of the ilium directly opposite the opening of x-ray tube.*

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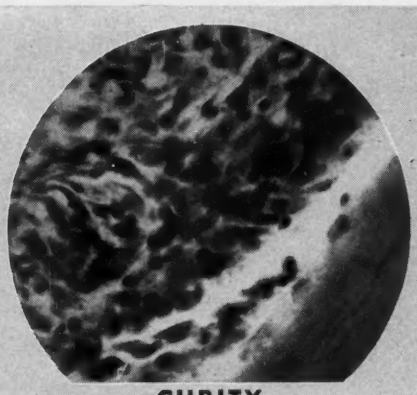

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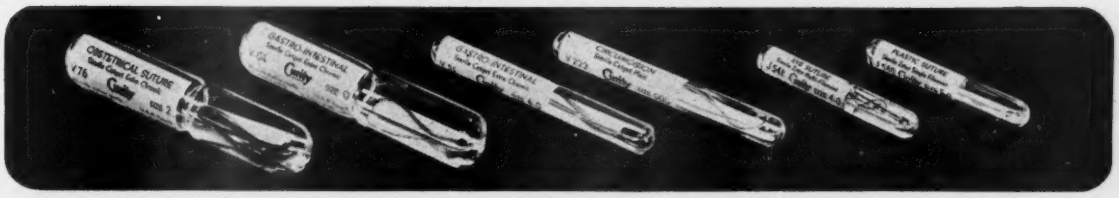

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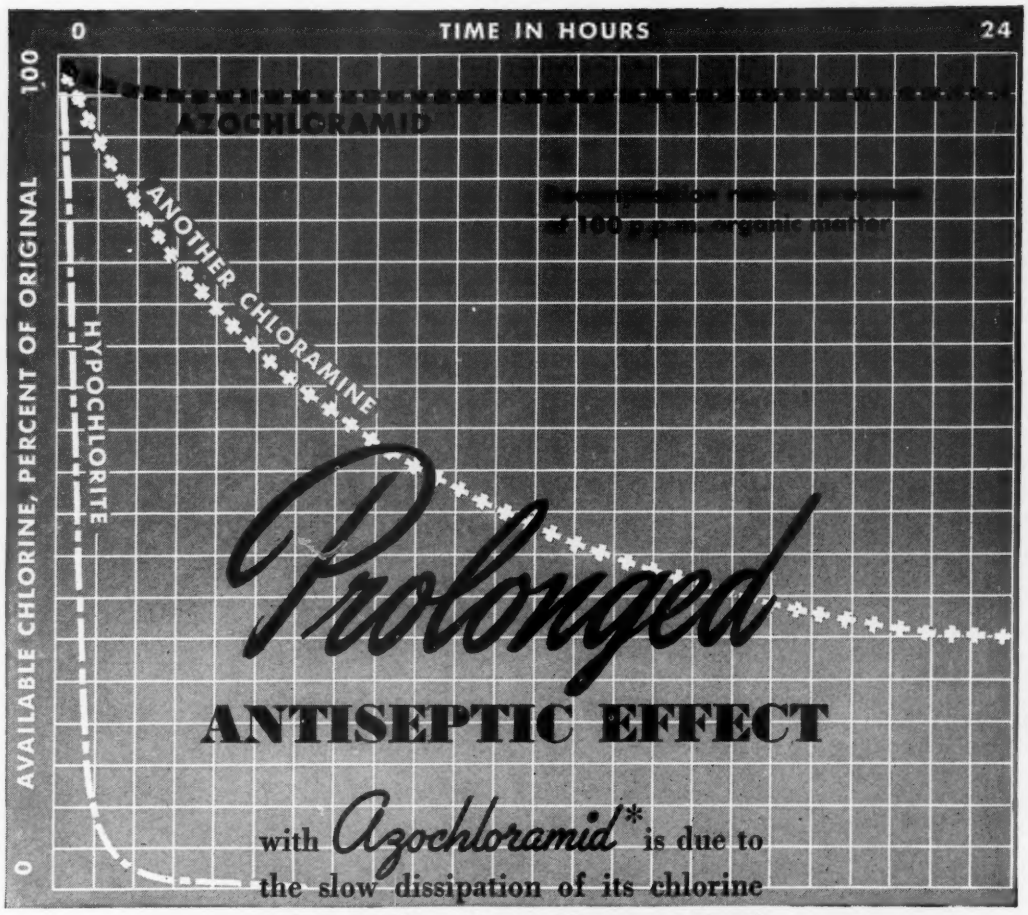


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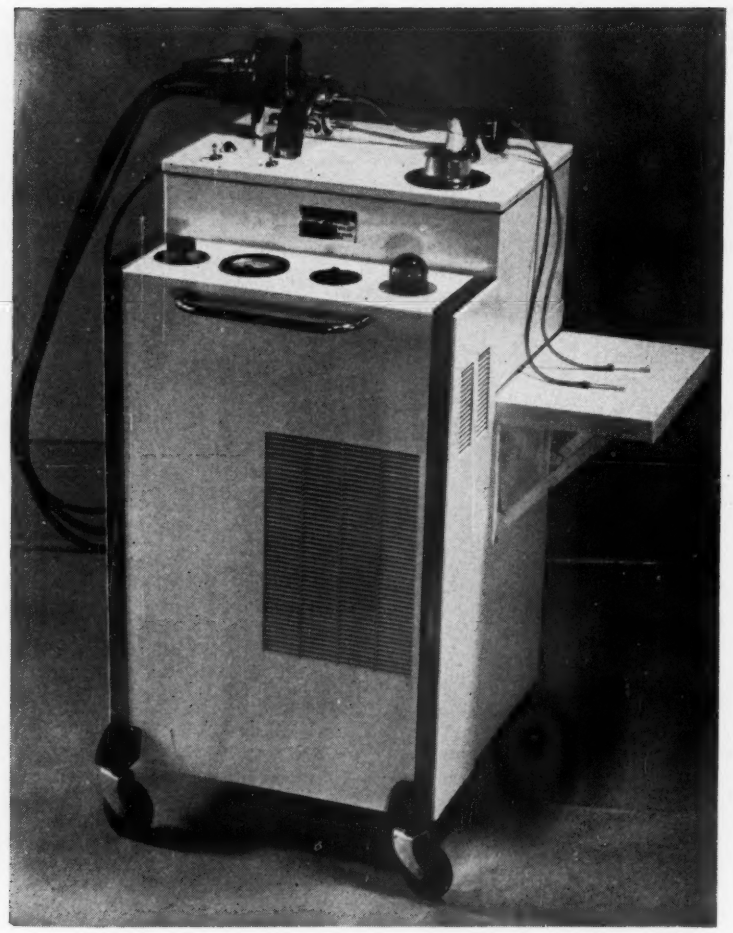

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**For Nurses – size 4¾" long – weight slightly over an ounce. Uses same size standard blade as Orderlies.**

**The leather cases (illustrated above) are scarce, though, and hard to get. If we have them when we get your order, we'll send them. If not, your razors will come attractively and serviceably packed in cellophane. So order promptly to have a chance at leather cases.**

**Orderlies' Size $1.50 each $18.00 dozen**
**Nurses' Size 1.00 " 12.00 "**
**Blades also available in cartons of 50@$3.34 a carton.**

***Immediate Shipment***

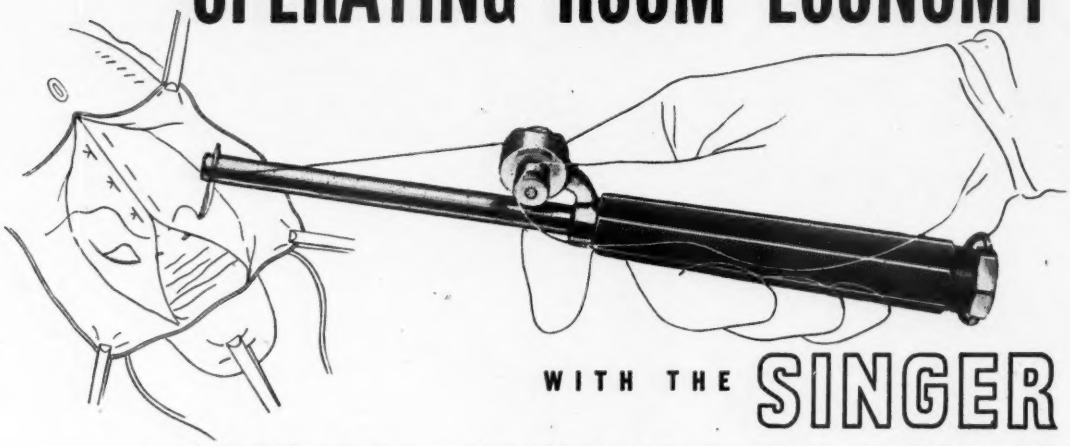
**Edward Weck & Co., Inc.**

**Manufacturers Surgical Instruments**

*SURGICAL INSTRUMENT REPAIRING · HOSPITAL SUPPLIES*

135 Johnson Street Brooklyn, N.Y.

# SAFER OPERATING ROOM ECONOMY



WITH THE SINGER

SURGICAL STITCHING INSTRUMENT

In advising an operation, the surgeon's sole consideration is the restoration of his patient's health. However, the institution in which the surgery is performed faces certain inescapable economic factors, particularly under present war conditions.

Among the sounder means of achieving economies in the surgical department, with—not less—but *more* consideration for the patient, is the routine use of the Singer Surgical Stitching Instrument.

By replacing numerous individually threaded needles with a single instrument possessing suturing capacity usually sufficient for use in the average operation, nurses can be released from elaborate sterilizing, threading and clamping preparations. And since the surgeon carries the instrument in his own hand constantly while suturing proceeds, attendance of assistants at the operating table may be safely reduced—thus aiding a depleted personnel to carry on with increased efficiency.

This new surgical instrument saves in material costs as well: It uses up considerably less suturing material, and employs a needle that lasts indefinitely. Any standard suture material may be employed, or any needle from a wide variety of available sizes, shapes, or styles—for use in either a deep or superficial field.

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*Illustrated booklet. Write Dept.* A-6
*Motion pictures demonstrating operative technique also available for group meetings.*

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*Personal demonstration available at your local Singer Shop*

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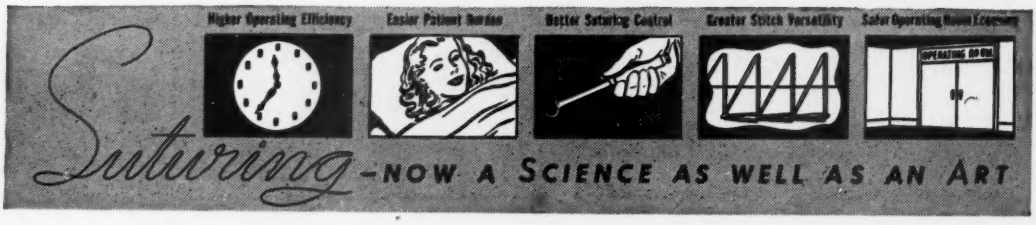
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Better Suturing Control
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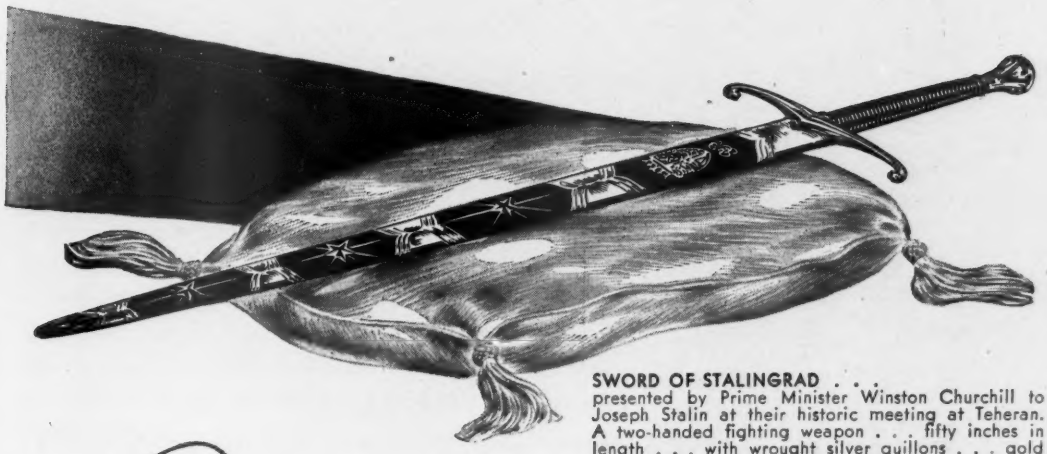

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**TEMPERED by England's leading swordmaker, old Tom Beasley of Wilkinson's Sword Company, the SWORD OF STALINGRAD is synonymous with perfection in swordmaking. In the surgical world, the name SKLAR stands for surgical instruments as nearly perfect as human ingenuity and years of experience can make them. SKLAR quality is as diligently guarded today as it was when the J. Sklar Manufacturing Company was founded over half a century ago. Only the highest quality materials and workmanship enter into SKLAR production. And it is this emphasis on quality . . . plus facility in adapting manufacturing techniques to surgical trends which has given SKLAR a character and personality all its own . . . made it an industrial leader in its field!** Sold only through accredited surgical instrument dealers.

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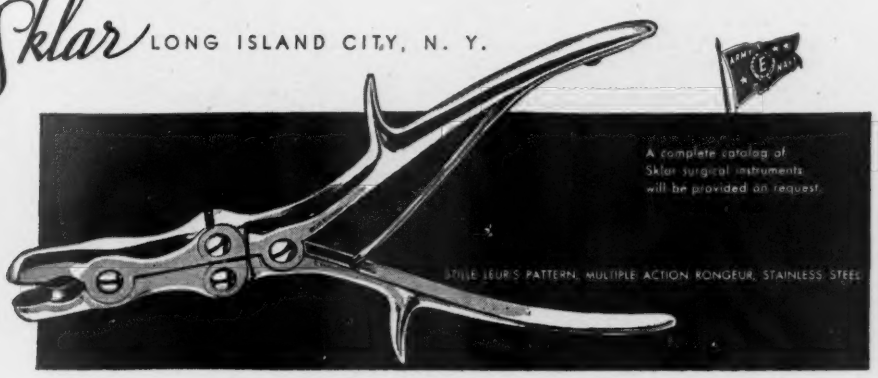
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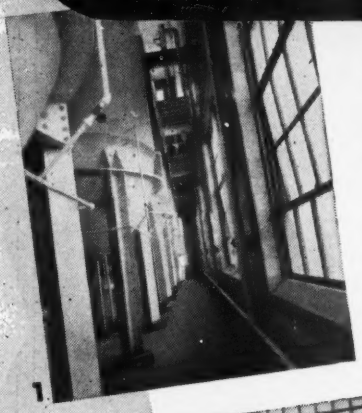
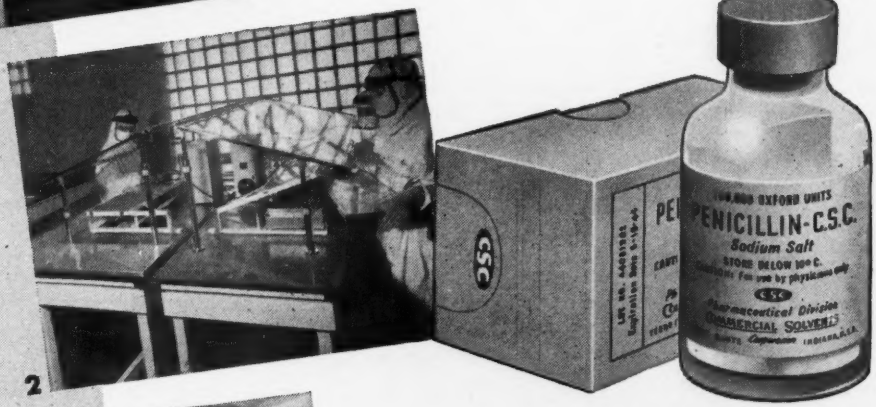
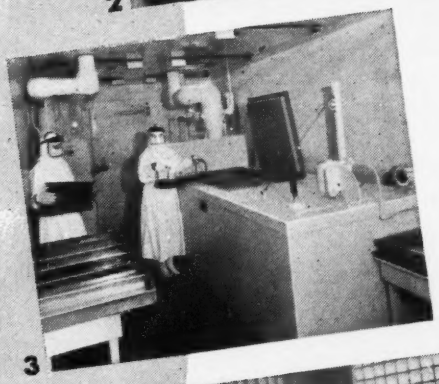
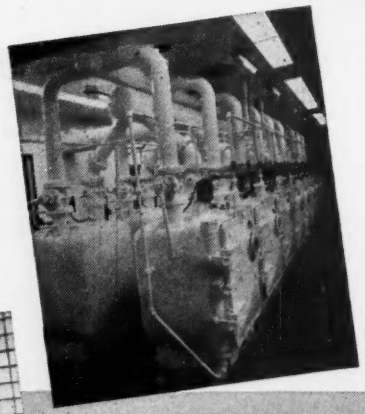
# *An Achievement in*
## PROTECTION AGAINST CONTAMINATION



1—Instead of the two-liter flasks in which penicillin ordinarily is made by "surface culture," Penicillin-C.S.C. is made in a battery of giant tanks, each of 12,000 gallon capacity, by "submerged culture," an operation of vastly increased sensitivity, calling for the utmost in care and control. 2—Vial-filling; note the safeguards against contamination. 3—Cold room, where Penicillin-C.S.C. is frozen prior to vacuum-drying.





4—The "last word" in controlled vacuum-drying equipment. The number of these evaporators indicates the magnitude of Penicillin-C.S.C. production. 5—Vial-sealing and capping.

# THE "Sterile Area" IN THE PENICILLIN · C.S.C. PLANT

WALLS of highly polished opal glass and translucent glass brick, and rounded wall, floor and ceiling abutments, permitting of maximum cleanliness—

air-conditioning that controls temperature, humidity, and particle content—

sterilizing lamps that destroy air-borne microorganisms—

sterilizing-lamp-controlled "locks" that prevent undue airflow from room to room—

sterile clothing (masks, gowns, shoes, gloves) worn by all technicians—

facial shields which carry the technician's breath away from the work area—

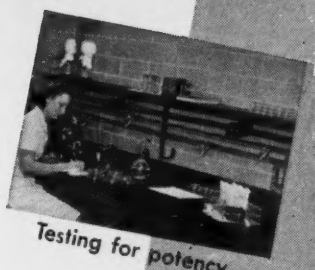
these are but a partial list of the safeguards employed in the "sterile area" of the Penicillin-C.S.C. plant.

Out of its quarter-century of research and experience in microbiotic production, Commercial Solvents Corporation has developed not only these safeguards, but also the "submerged culture" method which produces Penicillin-C.S.C. in giant three-story tanks.

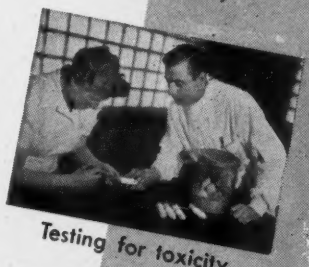
This combination of mass production methods, skilled personnel, the utmost in safeguards, and unremitting laboratory control spells two assurances—

Penicillin-C.S.C. will always be of dependable potency, sterility, and pyrogen-freedom—

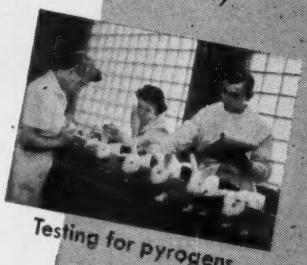
Penicillin-C.S.C., though now allocated as the armed forces direct, will be available in adequate distribution throughout the United States as soon as released.



Testing for potency



Testing for toxicity



Testing for pyrogens

PHARMACEUTICAL DIVISION

COMMERCIAL SOLVENTS Corporation

Penicillin Plant
Terre Haute, Ind.

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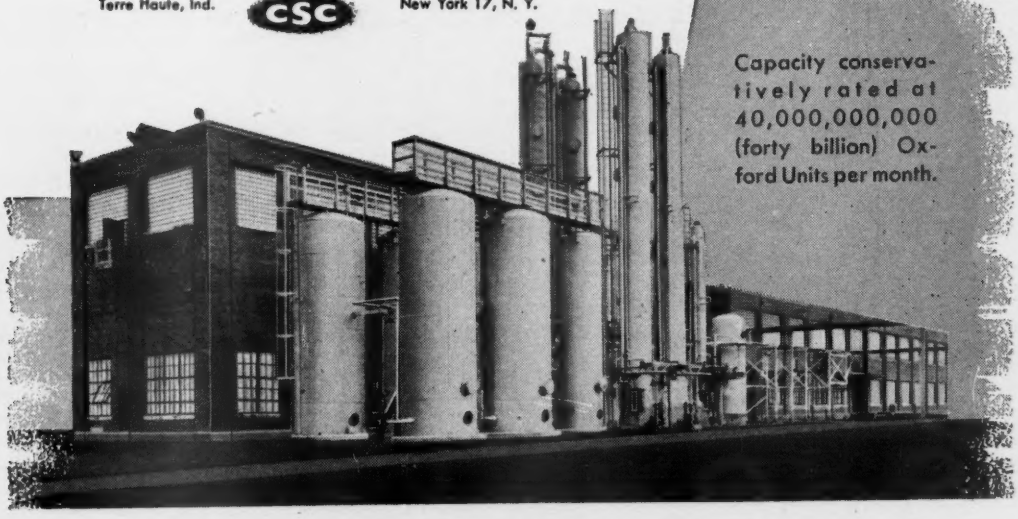
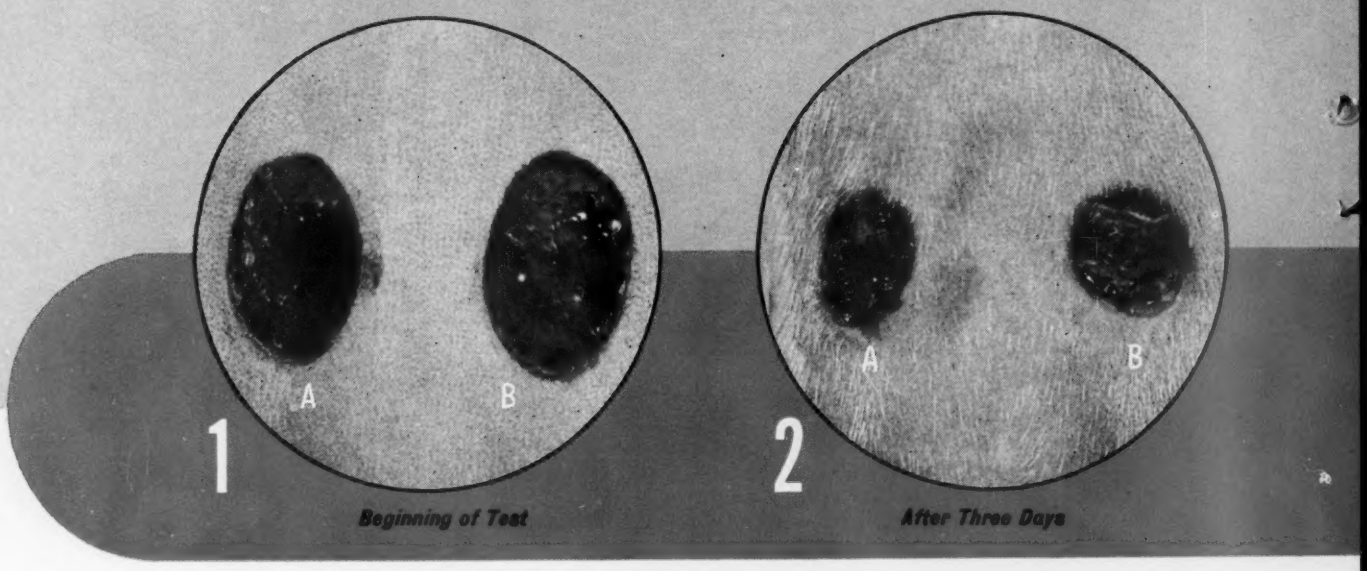


Capacity conservatively rated at 40,000,000,000 (forty billion) Oxford Units per month.

# THIS POWERFUL GERMICIDE DOES NOT INTERFERE WITH HEALING




AN OUTSTANDING characteristic of this new non-mercurial germicide is its complete lack of interference with the healing process—a fact that has been established both experimentally and clinically.

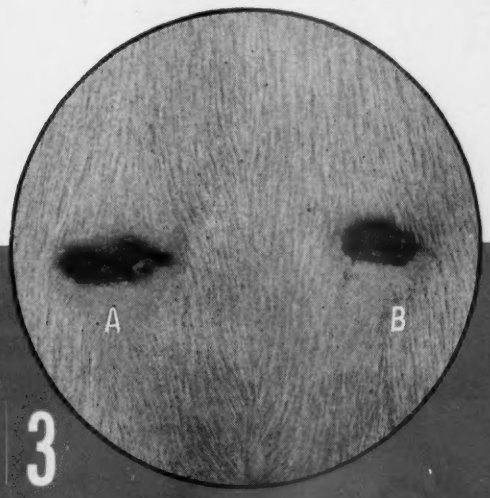
Ceepryn, a quaternary ammonium salt, is a distinctive advance in the antiseptic field, combining exceptionally high, non-selective bactericidal activity with negligible tissue toxicity.

Equally important are the penetrating and detergent properties of Ceepryn, which permit it to enter into, disinfect and cleanse folds of the mucosa and crevices and pores of tissue and skin.

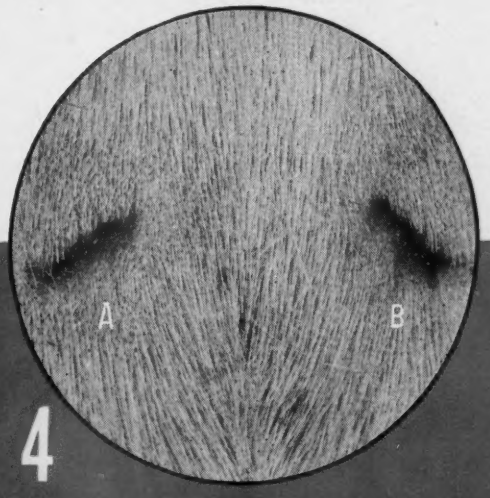
Ceepryn not only provides superior bactericidal and cleansing action, but is free from the irritating and corrosive effects of many commonly employed germicides such as iodine, phenol and cresol. It overcomes the chief limitations of the mercury salts, being considerably more potent in high dilutions, more active in presence of organic matter, much higher in penetrating ability and significantly lower in toxicity. It is superior to the active chlorine derivatives both in germicidal activity and stability.

# CEEPRYN

BRAND OF CETYLPYRIDINIUM CHLORIDE




*After Seven Days*




*After Sixteen Days—Complete Healing of Both Areas*

## CLINICAL ADVANTAGES:

- Potent, non-selective germicidal action in high dilution
- Effective against wide range of organisms
- Active in presence of serum
- Low surface tension—penetrating and detergent
- Low toxicity—no mercury, iodine or phenols
- Safe and non-irritating to tissue
- No interference with healing

## HOW SUPPLIED

- Ceepryn Concentrated Solution, 10.56% —180 cc. bottles

(*For preparing solutions and tinctures of any desired strength*)

- Ceepryn Aqueous Solution (Isotonic) 1:1000 —pints and gallons
- Ceepryn Tincture 1:200 —4 ounce, pints and gallons
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***Comparative Healing Studies on Control and Ceepryn-Treated Wounds***

The photographs record the relative healing rate of two wounds produced by removing identical skin areas from the abdomen of a guinea pig. In each picture, "A" is the contro! area which received no treatment, "B" is the area treated by daily application of Ceepryn Aqueous Solution 1:1000. It is apparent that the daily application of Ceepryn did not in any way retard healing of the wound.

Trade Mark "Ceepryn"
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THE WM. S. MERRELL COMPANY · CINCINNATI, U. S. A.

Parenamine
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*Ever-mounting Clinical data*

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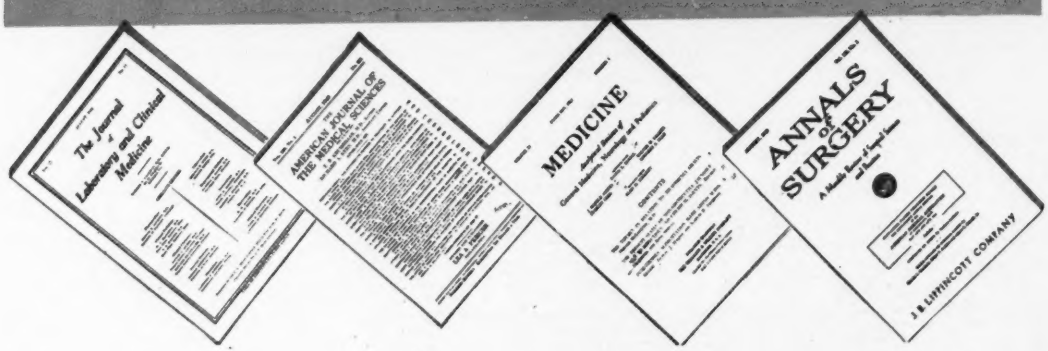
Confirm expanding use of this safe parenteral agent


The Journal of Laboratory and Clinical Medicine
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J. B. LIPPINCOTT COMPANY

# REPORTS ON SUCCESSFUL CLINICAL EXPERIENCES

Articles in recent issues of the medical press reveal the profession's growing appreciation of the value of Amino Acids as a therapeutic agent in the field of protein inadequacy. These continuing reports of favorable reaction and the ever-mounting data on successful clinical experience are responsible for the medical profession's rapidly increasing response to protein-nitrogen therapy and the expanding use of Amino Acids for the restoration of nitrogen balance.

Recognition of the importance of Parenamine (Amino Acids Stearns) in combating protein malnutrition has enabled us, in spite of difficult current conditions, to expand our production facilities sufficiently to meet this rapidly growing demand.

***Corrects dietary protein deficiency to restore adequate nitrogen balance***

To speed the healing of burns and wounds—to shorten days of convalescence after surgery—to check weight loss in wasting diseases—to assure adequate nitrogen balance wherever dietary protein intake is reduced . . .

These are some of the major functions of Parenamine (Amino Acids Stearns) which provides a reliable intravenous therapeusis where patients are unable to tolerate a high protein intake of food or are unable to take nourishment by mouth.

Parenamine may be administered parenterally or orally according to the severity of the condition.

*Available for parenteral and oral administration as a 15% solution in 100 cc. rubber-capped vials. Details of therapy on request.*

*Trade Mark* Parenamine
*Reg. U. S. Pat. Office*

Used post-operatively, Parenamine (Amino Acids Stearns) is finding rapidly increasing acceptance to prevent the development of hypoproteinemia and to correct protein deficiencies resulting from the operation.

Stearns Medical Division, through several years of intensive research, has accumulated a large fund of factual data and compiled an extensive bibliography. Correspondence is invited.

Frederick Stearns & Company

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# EASING THE POSTOPERATIVE ROAD

*The bacteriostasis of sulfanilamide and tissue stimulation of allantoin make* ***ALLANTOMIDE, "NATIONAL,"*** *a useful product in surgery.*

IF ALL convalescence from surgery was rapid, with no complications, the life of a surgeon would be an easier one. ALLANTOMIDE OINTMENT "NATIONAL", can help to make the postoperative road smoother by keeping the wound in a healthy condition, and by promoting granulation tissue the convalescent period will thus be shortened.

ALLANTOMIDE, "NATIONAL", is a water-miscible ointment containing 10% sulfanilamide and 2% allantoin. Sulfanilamide, the sulfonamide of choice for local use, tends to inhibit infecting organisms and thus maintains a clean, healthy wound. Allantoin encourages healing by promoting granulation and epithelization. It is also said to exert a chemical cleansing effect on necrotic tissue, permitting the sulfanilamide to exert its full bacteriostatic effect, although preliminary cleansing and the usually practiced surgical procedures are advocated.

ALLANTOMIDE is easy to apply; does not cake nor stain, nor does it irritate tissues. A thick eschar is not produced, thus permitting freedom of motion. A minimum of scars or contractures may be expected. A variety of burns, wounds, external ulcers and other conditions have been treated successfully with ALLANTOMIDE. Available in 1-ounce tubes, 4-ounce, 1- and 5-pound jars. Write for professional literature and samples to . . . The National Drug Company, Dept. B, Phila. 44, Pa.

NATIONAL DRUG COMPANY

# ALLANTOMIDE

BIOLOGICALS, BIOCHEMICALS, PHARMACEUTICALS FOR THE MEDICAL PROFESSION

## IN THE PROMOTION OF

# *Postsurgical Recovery*

Anemia remains an important factor in slowing up postsurgical recovery, though blood loss no longer plays a dominant role in surgery. Liver damage resulting even from the best of anesthesia, the enforced inactivity, and the resultant anorexia, all contribute toward promoting hypochromic anemia.

Heptuna has been found a valuable aid in speeding postsurgical recovery. It contains, in addition to an adequate amount of highly available iron, the fat-soluble vitamins A and D, and the B-complex vitamins (partly derived from liver concentrate and yeast). These vitamins not only make for optimal iron utilization but also improve the appetite and lessen fatigability.

**J. B. ROERIG & COMPANY**
536 Lake Shore Drive • Chicago 11, Illinois

# Heptuna

**EACH CAPSULE CONTAINS:**

| | |
|---|---|
| Ferrous Sulfate | 4.5 gr. |
| Vitamin A | 5000 U.S.P. Units |
| Vitamin $B_1$ (1 mg.) | 333 U.S.P. Units |
| Vitamin D | 500 U.S.P. Units |
| Vitamin G (0.50 mg.) | 500 micrograms |

*together with liver concentrate (vitamin fraction), derived from 4 grams of fresh liver and dried brewers yeast.*

# *He* won't dodge this-

# Don't *you* dodge this!

**The kid'll** be right there when his C.O. finally gives the signal . . .

There'll be no time to think of better things to do with his life. *The kid's giving all he's got, now!*

We've got to do the same. This is the time for us to throw in everything *we've* got.

This is the time to dig out that *extra* hundred bucks and spend it for Invasion Bonds.

Or make it $200. Or $1000. Or $1,000,000. There's no ceiling on this one!

Make no mistake! The 5th War Loan is the biggest, the most vitally important financial effort of this whole war!

5TH WAR LOAN

## *Back the Attack!* - BUY MORE THAN BEFORE

**The American Journal of Surgery, Inc.**

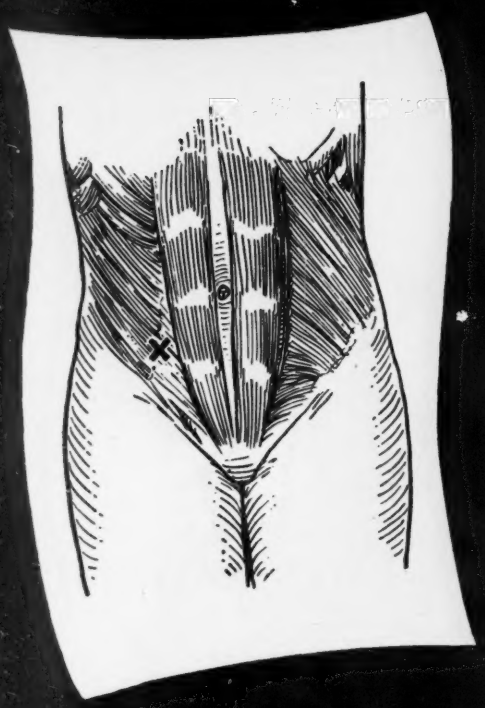
*This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council*

# Power alone is not enough

The shortcomings of sheer power are familiar to every surgeon. For, in preoperative disinfection, an antiseptic agent which offers power *alone* is useless. An efficient antiseptic must combine high disinfecting power with relative freedom from irritating effects and prolonged antiseptic action. Tincture Metaphen's superiority in this respect has been clearly established in an impartial, comparative study of 15 commonly used antiseptics.* On the oral mucosa, Tincture Metaphen 1:200 reduced bacterial count 95-100% within five minutes; caused only slight irritation in a few cases, none in the others; and had, in substantial excess over any other antiseptic tested, a duration of action of two hours. This antiseptic, in a *tinted* or *untinted* alcohol-acetone-aqueous solution, is conveniently available through hospital and ethical prescription pharmacies everywhere in 1-, 4-, 16-fluidounce and 1-gallon bottles. ABBOTT LABORATORIES, NORTH CHICAGO, ILLINOIS

*Meyer, E., and Arnold, L. (1938), *Amer. J. Digest. Dis., 5:418.*

**Tincture Metaphen 1:200**
REG. U. S. PAT. OFF.
(Tincture of 4-Nitro-Anhydro-Hydroxy-Mercury-Orthocresol, Abbott)



# SURGICAL ANATOMY

## *and Adhesive Strapping*

● A primary use of adhesive plaster is to pull tissues into place and hold them. *In all strappings the first strips should be applied parallel with the fibres of the underlying muscle, fascia, tendon or ligament, for good anchorage. Subsequent strips are applied in logical directions.*

The technique illustrated utilizes three layers of "ZO" Adhesive Plaster to splint the external and internal oblique and the transversalis muscles in the treatment of a tear or strain of the anterior abdominal wall.

Johnson & Johnson

## RED CROSS "ZO" ADHESIVE PLASTER

ORDER FROM YOUR DEALER

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A PRACTICAL JOURNAL BUILT ON MERIT

*Fifty-third Year of Continuous Publication*

NEW SERIES VOL. LXIV JUNE, 1944 NUMBER THREE

# Editorials

## THE OBSTRUCTED GALLBLADDER

WHY all this discussion about the proper treatment for "acute cholecystitis"? One says: "Operate early for fear of extension of the process to perforation and peritonitis." Another says: "Delay operation because in the acute phase operation is difficult and dangerous, and the patient's condition needs to be improved."

Often, in the discussion, "operation" is not defined but it is usually understood to mean radical cholecystectomy simply because this is the accepted way to handle cholecystitis.

And what is "early"? Is it "early" when a patient who has had gallstones for years suddenly develops a palpable, tender gallbladder? And do the advocates of "early" operation (cholecystectomy) believe that adhesions and sclerosis of years standing are softened in a few hours by the acute process, to such an extent that an operation, which would otherwise be a hard struggle, now becomes easy and safe?

It seems to be a passion with many surgeons to reduce all procedure to standards set by authority and statistics. Once I was told by a "Chief," "I want only standard, accepted methods used in this clinic." Is it more important to use standards than brains?

One recent editorial writer bemoans our chaotic ideas as to the treatment of acute cholecystitis and ends with a wish for better things; another advocates early operation but decides that about the only way to get a chance to do it is to educate the profession and the public. There is not much time to educate a patient with an acute condition of the gallbladder. However, I do agree that *the profession should be educated.* But shall we operate at once in every case that looks like biliary colic? Every patient with symptoms suspicious of gallstones should have cholecystography, and every patient with proved gallstones, who is not the poorest kind of risk, should be operated upon before acute cholecystitis develops. That is the early operation that counts, and even then many will not be early enough.

It seems that in the field of cholecystitis most of us beat about the bush, often stubbing the toe on the obvious culprit—the obstructing stone—but still keep on beating.

Years ago Denton discovered that blockage of the cystic duct, usually by a stone, is the cause of acute cholecystitis, through a two-fold action: (1) checking the return circulation, and (2) increasing pressure by preventing outflow of secretions and exudates. Of course this leads to edema and inflammation—often gangrene, infection and perforation.

A few of us not hooked by the belief that every inflammation must be primarily infective acted on Denton's findings in our practice and teaching. In almost every case of acute cholecystitis a stone can be found blocking the cystic duct; failure to find it in a narrow duct does not prove that it has not been there recently. Even in absence of a stone the duct will be blocked by inflammatory reaction.

For clarity of understanding, then, of the essential etiology and pathology, and consequently, of reasonable treatment, let us drop the term, "acute cholecystitis," call it "*the obstructed gall bladder*,"—and act accordingly.

A patient of middle age or past (usually harboring stones for years) develops "acute cholecystitis." Previously it has been called "biliary colic" or even "nervous indigestion." She has pain, tenderness and spasm in the upper abdomen, leucocytosis, vomiting, fever, maybe obstipation, maybe chills, maybe jaundice.

Effortless examination often reveals only muscle spasm in the right upper quadrant. But the right kind of an examination will usually demonstrate a mass below the liver, which, with inspiration, will gently slip under or against the hand held lightly on the abdomen. Time and patience, and the greatest effort, must be used because this is the most important sign as to the trouble and what to do about it, that is, if you use the minimum of pathological knowledge and common sense, and forget every article written, including this one. This sign will tell you, not whether you have acute cholecystitis, hydrops, gangrene, empyema or perforation; it will tell you that you have obstruction of the gallbladder, and yell for relief of that obstruction.

Usually this sign can be verified after the patient has had an anesthetic, even sedation and novocain. If after spinal anesthesia you can not palpate an obstructed gallbladder, you have something else.

Here I wish to point out the diagnostic advantage of a heavy dose of morphia following a careful first examination. This may allow definition of the mass. It may be against the rule; but reason, not rule, should be followed. It is so important to make the decision as to whether there is a definite mass below the liver, descending with inspiration, that it may even be worth while to give intravenous pentothal anesthesia for assistance to this end.

If such a mass is present, it is almost certainly an obstructed gallbladder. *The obstruction should be relieved in the shortest possible time by the most direct route.* There is no need for long preparation. Saline and glucose may be administered while you are working.

Spinal anesthesia or novocain and intravenous pentothal may be used.

Make a small incision below the liver margin over the gallbladder, perhaps a little above the mass because distention pushes the fundus downward. (Remember this, too, in diagnosis.) Furthermore, the fundus may be buried in adhesions, among which an angel will not tread. They may be plugging a perforation. If the fundus is not adherent, it may be delivered through the small incision. Now everything is under control. It is the simplest matter in the world to relieve the dangerous intravesicular pressure and save the patient.

If the fundus of the gallbladder will not deliver readily, and everything is covered by adhesions, open into the gallbladder below the liver margin, tearing down no more of the adhesions than necessary for identification of the gallbladder.

Aspirate, open the vesicle, evacuate contents, search inside the gallbladder with focusing headlight, ribbon retractors and sucker for the obstructing stone. If successful in removing this, you have loosened the key log in the jam, and drained the whole biliary system as well. Even if the obstructing stone cannot be removed at once, the back pressure having been relieved, it may loosen later; or perhaps it can be softened by Pribram's alcohol-ether application.

If you are one of those restless souls who cannot stop with a simple life-saving procedure, more can be done with little increased risk, but not by slashing the patient open and digging in a deep, dark and dangerous hole.

It is safe, however, to work inside the gallbladder. With the help of a focusing headlight, and using the electrosurgical unit, the mucosa of the gallbladder can be destroyed then and there by fulguration. If not completed the first time, the job can be finished later by the use of the coagulating current through a transurethral resectoscope in the sinus. Destruction of the mucosa results in obliteration of the gallbladder. The mucosa having been destroyed, it is no more necessary to remove the wall of the gallbladder than the wall of an abscess.

Injection of radiopaque material (diotrast) into the cystic duct, or into the sinus later, will tell (1) if the obstructing stone has been removed, (2) if all the gallbladder mucosa has been destroyed and (3) the condition of the hepatic and common ducts.

These last few paragraphs represent an ax of mine which I do not propose to grind further here. *The vital and urgent need is to relieve the pressure in the obstructed gallbladder.*

I am tempted, however, to present another conservative measure for handling the obstructed gallbladder. It, as well as the first method given, is a modification of Pribram's "Mukoklase," only slightly more risky than the other:

Split the gallbladder laterally far enough to remove the obstructing stone. Do not plunge for the cystic artery or try to dissect the duct. The duct has been located by splitting on the comparatively safe lateral aspect. Trim away redundant parts of the gallbladder but leave enough for a good cuff. Clamp and coagulate bleeders cut across in the wall. Thoroughly fulgurate the mucosa with the electrosurgical unit. The gallbladder should be split no farther than necessary to relieve the stone, preferably leaving a short funnel at the bottom. The mucosa here, however, should be fulgurated. Set a medium tube (large catheter) into the funnel-shaped lower end of the gallbladder or the cystic duct, and sew the edges of the cuff over it all the way up. The final result will be obliteration of the gallbladder, accomplished more easily and safely than by excision.

But first and above all the obstruction must be relieved to save life. The patient can be cured later by radical cholecystectomy if you will.

Lester R. Whitaker, M.D.

# THE TREATMENT OF WAR WOUNDS OF THE PERIPHERAL NERVES

THE conflict that is now raging will no doubt, as in the first World War, produce a large number of bullet and high explosive wounds of the upper and lower extremities. During the last war, the use of chlorine (Carrel-Dakin) solutions in the treatment of suppurating or probably infected wounds, and the procedure of wide extirpation of lacerated and torn tissues, resulted in the prevention of many infections and of greatly improved wound healing. However, the experiences of the first World War showed that of the large number of wounds of the peripheral nerves of the upper and lower limbs, the neural lesions were sometimes produced by the surgeon. They resulted either from the wide excision of injured tissues without due regard to large nerve trunks in the neighborhood, or possibly due to a lack of exact knowledge of the course of the large nerves in the extremities.

This may appear to be an unjustified criticism of some of the surgery that was done. The writer had occasion to operate upon a large number of soldiers with injuries of the peripheral nerves after they had been invalided home from the battle

fronts, and occasionally there was indubitable evidence that complete interruption of the functions of large nerves such as the ulnar, musculospiral, sciatic or external or internal popliteal had followed immediately after the mass extirpation of lacerated tissues.

Large nerve trunks, even if they traverse or are in the immediate neighborhood of an area of lacerated tissue, may be preserved with safety even when much torn muscle tissue has to be removed surgically. Large, uninjured nerves offer considerable resistance to infection, and their preservation will not greatly, if at all, increase the dangers of a secondary wound infection. Moreover, a large uninjured nerve trunk may be preserved even though it traverses a region in which infectious agents have been implanted or even in an actual area of suppuration. Therefore, especially with the modern sulfathiazole treatment of wounds, every effort should be made by the surgeon to safeguard large nerves that have not been injured or that have been only slightly traumatized.

Such a course may diminish the number of cases in which secondary suture of divided nerves becomes necessary. Especial care should be taken of these nerves in which regeneration after nerve suture is poor, e.g., the ulnar nerves in the upper and the popliteal nerves in the lower limbs.

It is to be hoped that the follow-up of patients, in whom divided nerves have been secondarily sutured and the cases in which autotransplants have to be used in order to bridge nerve defects, will be better after this than after the first World War. After that conflict, the efforts of a small group of neurological surgeons to organize an efficient follow up in these patients, were not successful. As a result, our knowledge is still meagre of the final results of the large number of operations on individuals in whom nerve defects had to be bridged by autogenous nerve transplants.

Charles A. Elsberg, M.D.

# Original Articles

## PARALYTIC SCOLIOSIS

### AN ANALYSIS OF FIFTY-ONE CASES

SAMUEL KLEINBERG, M.D.
Diplomate of the American Board of Orthopedic Surgery
NEW YORK, NEW YORK

THE treatment of structural scoliosis of whatever origin has always been a serious problem. The results of treatment are still very far from satisfactory, although considerable progress has been made. Modern, comparatively simpler and somewhat surer measures have replaced the older methods of therapy. In view of the fact that there is no cure for scoliosis, in the sense of a complete restitution to the anatomical normal, treatment is necessarily limited to the following two objectives: First, and perhaps the more important, is the prevention of further increase of the deformity; second is the improvement or reduction of the curvature. With this specific goal in mind we may say that idiopathic and many of the other non-paralytic types of structural scoliosis may be fairly well controlled. We can expect that in the majority, perhaps in 70 to 80 per cent of the mild and moderate cases, through the use of one or another of several well established systems of treatment, the scoliosis may be arrested, or occasionally even permanently improved.

Scoliosis complicating acute poliomyelitis is a very much more troublesome problem than that of idiopathic and non-paralytic curvatures. The difficulties are due to many factors, each of which arises from or is related to the poliomyelitic disease. The features or characteristics of paralytic scoliosis which merit special comment, because they influence our concept of the etiology and the modalities of therapy, are the following:

*The Plastic State of the Tissues.* A patient who has had an attack of infantile paralysis has had an acute illness which often depletes the entire system of strength and resistance. Many of the muscles are partially or completely paralyzed. The circulation, especially in the legs, is often visibly poor. There are periods varying from months to years during which the patient is physically inactive even to the extent that he does not stand or walk, either because of the degree and extent of the paralysis, or because of the use of special apparatus or reconstructive surgery. As a result of the above circumstances the muscles and ligaments may be atrophied, and either stretched or contracted. The bones may be decalcified with decidedly diminished resistance to deforming stresses. In this weakened and plastic state all the bones, and particularly the vertebrae, are readily susceptible to structural alterations and may and do become deformed.

*Onset.* Paralytic scoliosis appears insidiously. Its existence and even increase may not be recognized because they are overshadowed by more evident disabilities of the extremities which urgently require our attention.

*Static Imbalance.* There is a manifest static imbalance in poliomyelitis because of the unequal involvement of the muscles of the trunk and especially those of the pelvi-femoral groups.

*Progress of Paralytic Scoliosis.* The deformity of paralytic scoliosis usually increases slowly over a period of several

years. Occasionally, the curvature remains mild. Generally speaking, the more extensive the paralysis the greater will be the curvature of the spine. A particular feature of paralytic scoliosis is the tendency, after a stationary period of sometimes several years, for the curvature suddenly and without recognizable cause to increase and to become rapidly severe. Such an abrupt aggravation of the curvature rarely occurs in the idiopathic variety except after an exhausting illness, such as diphtheria, pneumonia or typhoid fever, which puts one on his guard and permits one to institute preventive measures. Paralytic scoliosis may even increase while the patient is undergoing supportive or even corrective treatment. Too often the curvature advances to a severe, so-called "razor-back" or kyphoscoliotic type. The deformity of the spinal column may increase even after an extensive and technically seemingly adequate vertebral fusion, especially if the postoperative care is not continued for several years.

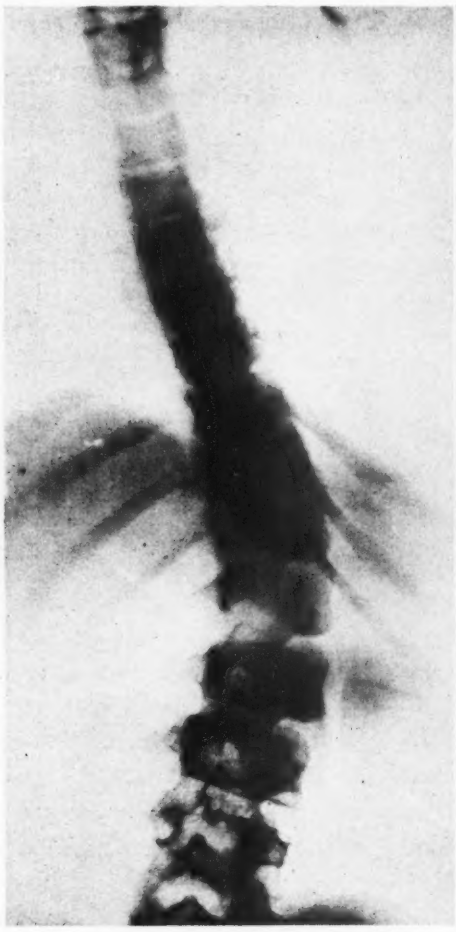

Fig. 1. W. E., paralyzed in 1923. This film made in 1928 shows a comparatively mild scoliosis.

Fig. 2. W. E., 1932. Two years after thoracic spine fusion; scoliosis has markedly increased.

*Trophic Changes.* We are all aware of the great tendency in poliomyelitis to laxity of the soft tissues, particularly the ligaments, and to demineralization of the bones. These conditions result in a plastic state, referred to above. There is still another cause for the plastic state, namely, trophic disturbances in the bones from disturbed innervation and impoverished circulation. Trophic changes such as bluish discoloration and ulcerations are often evident in the skin of the legs. Trophic changes are equally common in the bones

of a paralyzed limb. The size of the bone may be reduced in length and thickness. In fact, a bone may be retarded in growth so that it may be several inches shorter than the corresponding bone in the well limb. The cortex may be so thin that it can be easily indented, cut readily with a scalpel and bent manually to any position. On section the marrow appears pale and the bone lamellae thin. It is my belief that in paralytic scoliosis the vertebrae are not only in a plastic state from demineralization but are weakened structurally from trophic changes. Under these pathologic conditions the spinal column gives way to deforming forces and a rotary lateral curvature ensues. Abnormal stresses and tension which in the normal state would be inconsequential are adequate to initiate a scoliosis in poliomyelitis. A shortened leg in an otherwise normal child seldom causes scoliosis. In fact, 14 per cent of the population has some inequality in the length of the legs, but this disparity in length does not give rise to a scoliosis unless there is some additional physical defect or complication. In a normal child support of an arm in a shoulder spica, for instance, for a fracture at the shoulder or in the arm, would cause no concern about the possibility of the development of a scoliosis. But in a child afflicted with poliomyelitis the wearing of a plaster shoulder spica and the consequent and associated malposition

Fig. 3. W. E., 1939. Film made several years after fascial reinforcement of abdominal wall and lumbar spine fusion; scoliotic deformity has increased to a very severe degree.

of the trunk may frequently lead to a scoliosis, as it did in Case IV of the present series.

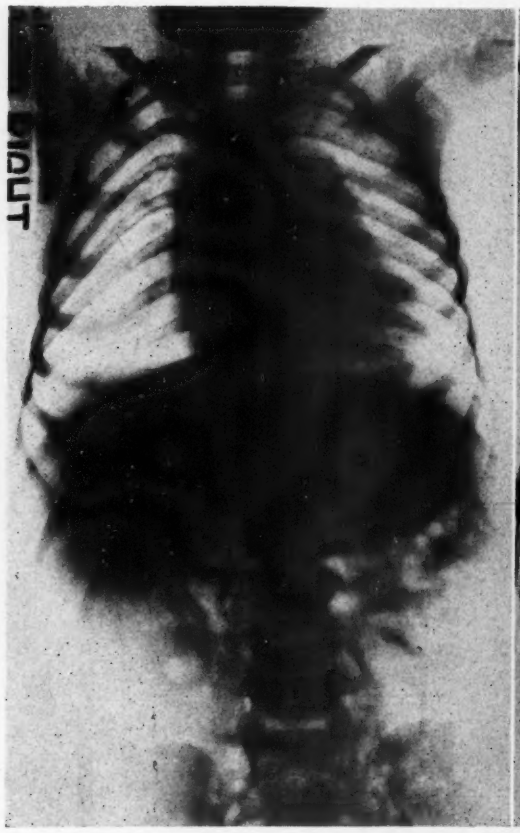

Fig. 4. A. C., paralyzed in 1931. This film made in 1932 shows a mild right dorsal curvature of the spine.

Fig. 5. A. C., 1937. The patient had an abdominal fascial operation and continuous support of back, but scoliosis increased.

*Unknown Etiological Factor.* A completely symmetrical distribution of muscle involvement in poliomyelitis is almost never present. Thus, muscle imbalance is the rule. This condition and all the others above mentioned, trophic changes, contractures, leg shortening, faulty postures, and so forth, can produce a scoliosis. Yet in the vast majority of poliomyelitic patients these disturbances are present but a scoliosis does not develop. We must, therefore, assume that in paralytic scoliosis, and actually this is true of all types of scoliosis, there is still another factor, as yet undiscovered, which initiates or influences the appearance and development of a curvature of the spine. I invite an open mind on the question of etiology, not to confuse the issue, but in the hope that more light will be shed on it in the future. It is not enough to say that a given physical impairment or defect causes scoliosis, for many patients with the identical defect do not develop scoliosis. What we have been calling causes are probably only contributory elements, the real cause of scoliosis remaining undiscovered.

From the above observations it is, I believe, apparent that the treatment of paralytic scoliosis is essentially symptomatic and empirical. The treatment aims to correct mechanical derangements, wherever discovered, in the back, chest, abdomen or the extremities, and to reinforce the resistance of the vertebrae by fusing them over a variable segment of the spine. The elements requiring treatment can best be brought into relief by an analysis of the salient characteristics of paralytic scoliosis. With this in mind I have reviewed the

histories of fifty-one cases treated in recent years on the various orthopedic services at the Hospital for Joint Diseases. It would probably have been better had each case been analyzed and evaluated by the original observer. Yet the study has yielded information which appears to apply to all of the cases on whatever service and under whatever therapy, and represents a cross-section of our experience with this deformity. Conference with my colleagues has shown that they share with me a profound pessimism about the results of the present treatment, and an enthusiasm for more aggressive therapy.

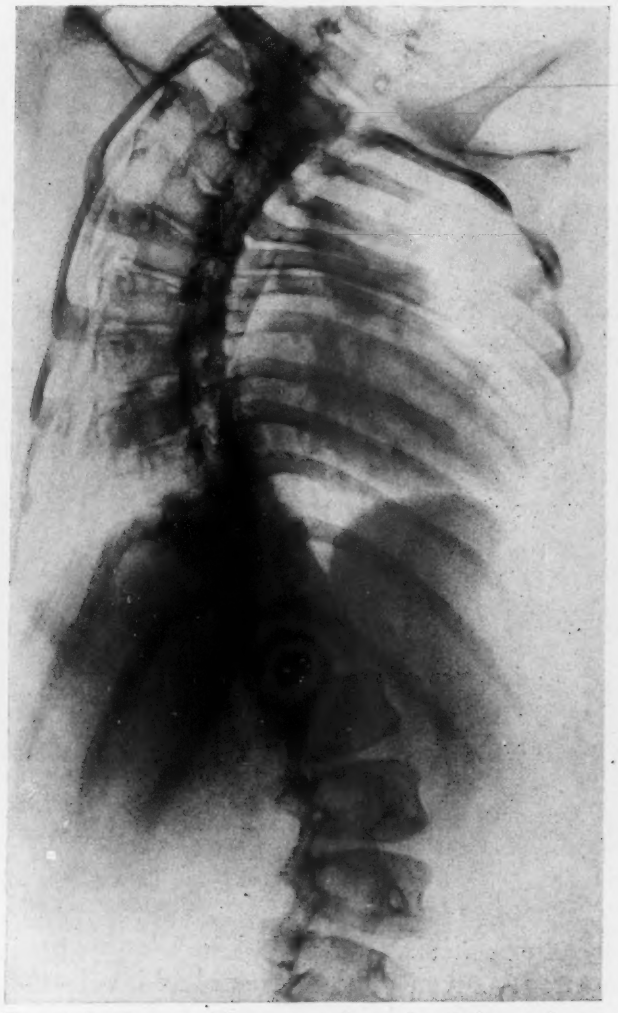

Fig. 6. A. C., 1942. Five years after spine fusion and continuous support; deformity has increased to a "razor-back" scoliosis.

*Incidence.* It is difficult to obtain entirely accurate statistics on this phase of our problem. A study made by me several years ago and my present impression lead me to believe that scoliosis complicates poliomyelitis in only about 5 to 10 per cent of the cases. Yet in a recent study by Colonna and Von Saal* the authors found an incidence of 30 per cent, although they considered the percentage surprisingly high. The incidence, at its lowest is still sufficiently high to warrant continuous vigilance in the care of a poliomyelitic patient.

*Sex.* Paralytic scoliosis affects boys and girls about equally. In my present

* Colonna, Paul C. and Von Saal, Frederick, A study of paralytic scoliosis based on five hundred cases of poliomyelitis. *J. Bone & Joint Surg.*, vol. 23, pp. 335–353.

series of fifty-one cases there were thirty females and twenty-one males. This difference is not very marked and would, I am sure, be reduced in a larger count.

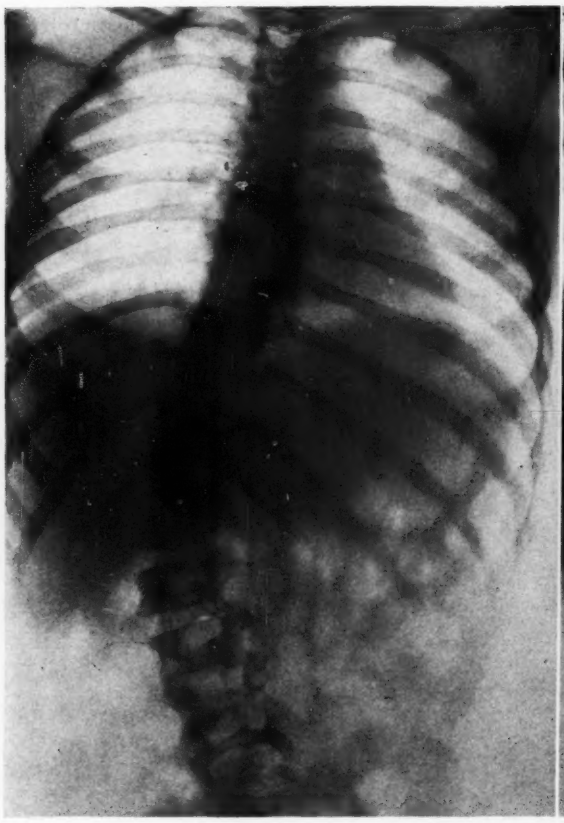

Fig. 7. D. T., paralyzed in 1931. This film made in 1936 shows a mild scoliosis.

Fig. 8. D. T., 1939. Deformity worse than in 1936 despite continuous and adequate protection of the back.

*Time of Onset of Paralytic Scoliosis.* Our records show that in twenty-seven of the fifty-one cases, slightly more than 50 per cent, a scoliosis was recognized within five years of the acute onset of the poliomyelitis. In one case it was six years and in another ten years after the acute attack before a scoliosis was discovered. In twenty-two cases the time of recognition of the scoliosis is not recorded. The significance of these figures lies in the need for anticipation of the possible appearance and the early recognition of a scoliosis to permit the most effective application of corrective therapy.

*Muscle Paralysis.* Theoretically, scoliosis might be found in poliomyelitic cases in which there is such mild involvement of the muscles clinically that the paralysis is not apparent. Yet in this unselected series of fifty-one cases all of the patients, with but one exception, had a very extensive distribution of muscle paralysis. Many of them had involvement of several limbs and not a few had paralysis in all the limbs. Many of the patients had so much muscle paralysis that they could not get about except by the combined use of one or two leg braces, spinal supports and crutches. The scoliosis was only a part of a picture of generalized and extensive paralysis with multiple deformities. One is naturally inclined to the conclusion that scoliosis should be expected when there is an extensive muscle paralysis. Conversely, when there is only limited and isolated paralysis, especially in one limb, there is little likelihood of the appearance of a scoliosis. I have no available statistics on this latter point but believe it to be true from a mental review of the cases which have

come under my care. In this connection we must note a very significant finding, namely, a very high incidence of paralysis of the abdominal muscles. Abdominal paralysis was recorded in thirty-eight of the fifty-one cases, nearly 75 per cent. This figure is undoubtedly low since abdominal paralysis may have been present in some of the other cases but not recorded. The percentage of abdominal paralysis is so high that it may be seriously questioned whether this is perhaps not the dominant factor in the development of the spinal curvature. Weight is added to such an assumption by the fact that most of the curvatures in the present group were dorsolumbar in type, the convexity of the curve corresponding generally to the side of the paralytic or weakened abdominals.

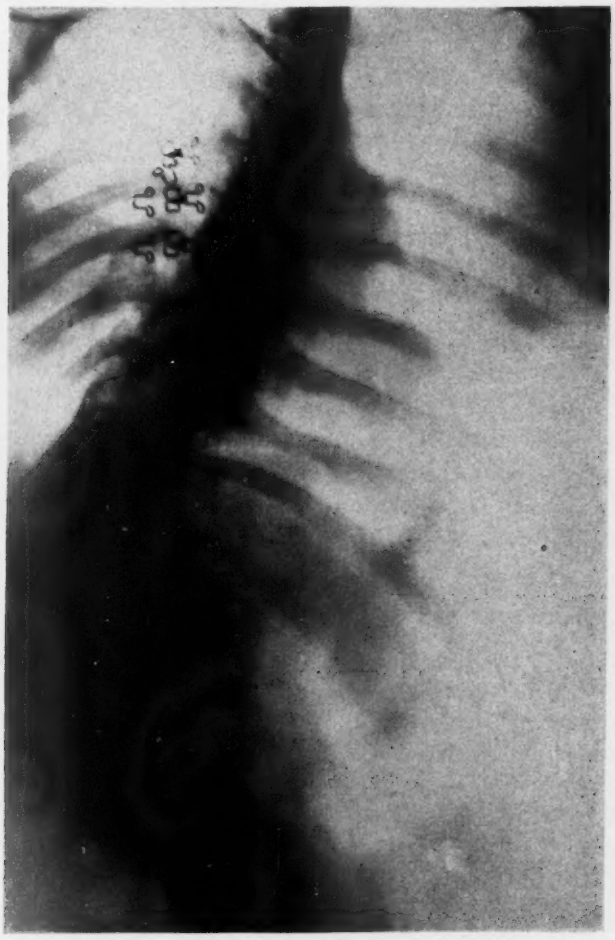

Fig. 9. D. T., 1942. Spine fusion done in 1939; deformity has increased considerably since then.

*Types and Degree of Curvature.* The type of curve was indicated in thirty-four of the fifty-one cases. Of this number (thirty-four) fifteen had right dorsolumbar curves and eight left dorsolumbar curves. Thus, in two-thirds of thirty-four cases there was a single long curve involving most or all of the dorsal and lumbar vertebrae. The degree of the curvature was indicated in thirty-eight cases. Of these only two were mild, five were moderate and thirty-one, or 80 per cent, were severe, and many of these had "razor-back" deformities. The great frequency of the severe curvatures renders it all the more imperative that paralytic scoliosis be recognized early and treated vigorously.

*Treatment Applied.* From our knowledge of the requirements for the surgical repair and reconstruction of paralytic deformities, we can readily appreciate the

multiplicity of procedures that were needed and instituted in this group of fifty-one disabled individuals. There were myotomies, tenotomies, astraglectomies, Hoke stabilizations, tendon transplants, tenodeses, arthrodeses, osteotomies of all varieties, leg lengthening, abdominal fascial reinforcements and spine fusions. I am happy to say that in practically all of the cases the operations, singly or in combination had a wholesome effect in returning to the patient some measure of independence in the use of the limbs, and security in standing, sitting and walking.

*Results of Spine Fusions.* Our specific interest in this study was to determine the effect of spine fusions on paralytic scoliosis. The results are disappointing because the percentage of failures was 80, that is, failure to arrest the scoliosis and prevent its increase, which is the chief aim in all therapy of scoliosis. The reasons for these failures are many but not each of them naturally is found in every case. Perhaps at this juncture the obvious fact that is sometimes overlooked should be emphasized, namely, that even in a perfectly fused spine the curvature may increase in much the same way as a solid limb of a tree may and does become bent, twisted and deformed from various forces of stress and tension and the force of gravity. In fusing a spine we only increase the resistance to the deforming forces but do nothing to eliminate those forces. It is true that in many cases deforming influences were minimized as when weakened abdominals were reinforced, a shortened limb compensated or a pelvic obliquity corrected. Yet even under these conditions much of the muscle imbalance and the static imbalance remained. In addition, the average spine fusion was not performed until five years after the onset of paralysis, so that the scoliosis frequently advanced to a considerable degree before the circumstances in the case demanded or permitted the spine fusion. Some of the patients travelled extensively from one hospital clinic to another before accepting the suggestion of a spine fusion. Some were such poor surgical risks that delay in performing the fusion operation was imperative. In some cases the fusion did not include enough vertebrae, and in a few a pseudarthrosis was present. A alysis of the successful cases also gives no clue as to why treatment was successful in them and not in the others.

As was previously noted, there was an abdominal paralysis in a large percentage of the cases in this group. It might be anticipated from this fact that abdominal fascial reinforcement would yield a high percentage of success. Perhaps this would be true if it were performed early and in every case before the scoliosis advanced. Nevertheless, our figures, while covering only a small number of cases, give no such glimpse of success. Twenty-one of our patients had abdominal fascial operations. In fourteen of these there were also spine fusions. In this group there were three successes, six failures and unknown results in five cases. In the remaining seven patients in whom the scoliosis was treated by jackets and braces, without a spine fusion, there were two successes, three failures and two with unknown results. Apparently, the results without a spine fusion were about as good, or rather as bad, as those with a spine fusion. It is not intended to draw any sweeping conclusions from figures in such a small group of cases. Moreover, each deformity must really be judged by the associated lesions and the general condition of the patient.

In all instances in which a spine fusion was performed there was adequate preoperative treatment by corrective jackets or traction on a convex frame to reduce the curvature to the potential minimum before fusing the vertebrae. From three to fourteen vertebrae were fused depending upon the type and degree of the curvature and the surgeon's judgment as to the requirements of the case. Most patients had a fusion of at least eight vertebrae performed in one or several stages.

## CASE REPORTS*

CASE I. William E., twenty-four years old, was paralyzed in 1923 at the age of five years. Originally, he had very extensive involvement of all of his limbs, the back and abdomen. He received the orthodox treatment and gradually improved. In 1928, he had a mild scoliosis. (Fig. 1.) He was treated for this by preliminary traction on a convex frame and a fusion operation in the lumbar area. Subsequently, he was adequately and continuously protected by plaster jackets and corsets. However, the deformity increased, and in 1930 he had a fusion operation on the thoracic segment of the spine followed by prolonged bed rest and immobilization of the back by plaster jackets and later a celluloid corset. The deformity continued to increase and by 1932 he had developed a razor back. (Fig. 2.) The spine fusions had failed to arrest the scoliosis. In 1932, he had fascial reinforcement of the abdominal wall, and a revision operation on the lumbar area for a possible pseudoarthrosis. The lumbar fusion was found to be solid throughout. The deformity continued to increase and in 1939 (Fig. 3) the scoliosis was far worse than in 1932. In retrospect the management of this case might have yielded a happier result had the abdominal wall been reinforced and the entire spine fused in 1928 when the scoliosis was mild.

CASE II. Anthony C., thirteen years old, was paralyzed in 1931 at the age of twenty-two months. He has been continuously under my care. Originally, he had involvement of all his limbs, the abdomen and the masseter muscles. He was treated by the orthodox system and gradually improved. Two years after the onset of the poliomyelitis a mild right dorsal curvature was observed. (Fig. 4.) Shortly thereafter an abdominal fascial reinforcement was done in the hope that it would arrest the progress of the scoliosis. His general condition at this time was very poor and did not warrant a spine fusion operation. Hence, the scoliosis was treated by the use of supportive apparatus. He was sent at this time to a convalescent home where, under a regime of forced feeding and much bed rest, his health improved considerably. The scoliosis, however, increased and four years later was quite severe. At this time he had a fusion operation on the thoracic vertebrae and thereafter uninterrupted support of the trunk. The curvature increased some more (Fig. 5) requiring a resection of the ribs on the convex side which had become sharply angulated. He is still wearing a spinal brace. In this case none of the measures employed served to arrest the scoliosis, and our treatment of this deformity has been a complete failure. An *x*-ray film made in 1942 (Fig. 6), five years after the spine fusion shows a further increase of the deformity.

CASE III. Doris T., fourteen years old, came under my care when she was one and one-half years old for a congenital bilateral dislocation of the hips. The dislocations were fortunately readily reduced. One year later she had an attack of poliomyelitis involving chiefly her lower limbs for which, in the course of time, a bilateral astragalectomy was required. Five years after the onset of the poliomyelitis a mild right dorso-lumbar scoliosis was discovered. (Fig. 7.) She was promptly treated by traction on a convex frame and a thoracic spine fusion. Subsequently and continuously up to the present time she has had support of her back. We used at first plaster jackets and then a celluloid corset, and latterly a spinal brace. The curvature gradually grew worse (Fig. 8) and in 1939 the lumbar area was fused. Since then the curve has increased some more. (Fig. 9.) In a recent examination there seemed to be some weakness of the right abdominal muscles. This abdominal weakness must have been overlooked and may, perhaps, account for the continuous increase in the curvature. The spine fusions certainly failed to check the scoliosis. Perhaps the whole of the lumbar as well as the dorsal segments of the spine should have been fused when the scoliosis was first observed.

The preceding review of our experiences with paralytic scoliosis in a group of fifty-one unselected cases, and especially the analysis of the results of the use of the spine fusion operation for this deformity, presents a very discouraging picture. The high percentage of failures would tend to give us an attitude of defeatism were it not for the fact that the poor results from current methods of treatment challenge us to seek measures that will give us better

* The author is indebted and grateful to Drs. Mayer, Jahss, Sonnenschein, Zadek and Milch for permission to include some of their cases in this study.

results. Consequently, let us consider first, the prophylaxis, and secondly, the type of therapy which may yield improved results.

## PROHYLAXIS IN PARALYTIC SCOLIOSIS

*Early Recognition of the Deformity.* Remembering that paralytic scoliosis is likely to occur in an extensively paralyzed patient, we must be on the lookout for a spinal curvature. And having discovered a scoliosis we must never forget or overlook it in all subsequent treatments. Often a limp, a distortion of an ankle or a relaxed and drooping shoulder so engrosses the attention of the parents and the patient that they see little else. But we must not be diverted from our interest in the spine by what, at the moment, most concerns the family. In our examination we must note and record all the physical defects. A scoliosis, be it ever so mild, is a danger signal, for it may at any time, and very rapidly, become a conspicuous and incurable distortion of the whole trunk. Having found a scoliosis we must proceed methodically to prevent its increase.

*Maintenance of Symmetry of the Trunk.* Continuous effort should be made to keep the trunk in a symmetrical attitude. To accomplish this in a patient confined to bed one may have to use cushions, sand bags, traction on one or both legs or a plaster bed. If he is sitting a large part of the day, it may be necessary to adjust the seat, back, arms or foot pieces of the chair to prevent faulty posture. If the patient is able to stand or walk, a shortened limb must be compensated for by an appropriate lift. Leg braces, if worn, should be inspected periodically to make certain that malposition of the trunk is avoided. Crutches, when used, must be exactly right in length.

*Support of the Back.* In many instances the trunk may have to be protected against a tendency to a lateral or anteroposterior shift by employing supports such as a canvas corset, a celluloid corset, a brace or a plaster jacket.

*Reconstructive Surgery.* Most of the patients in this group of paralytics require reconstructive surgery. This should be performed as soon as it is reasonably certain that the phase of spontaneous improvement has passed. Stabilization of a dangle shoulder or ankle, correction of a genu recurvatum or pelvic obliquity or a flexion at the hip, the reinforcement of a weakened abdominal wall or a paretic quadriceps tend to improve stability and stance, and hence prevent the occurrence or the progress of a scoliosis. As far as possible the operation planned should be simple and not entail a prolonged convalescence. Complicated operations provide much opportunity for academic dissertations but afford little change for the patient's rapid recovery.

*Exercises.* Since inactivity in poliomyelitis rapidly leads to atrophy of muscles, relaxation of ligaments and demineralization of bone, the surgeon must constantly seek to prevent these effects by making the patient engage in exercises specially suitable for him. This is particularly indicated for those confined to bed or restricted by apparatus. This phase in the prophylactic program should preferably be directed by the surgeon himself who can best appreciate the type, degree and amount of bodily exercise that will be most beneficial to the given patient.

*Fascial Reinforcement of the Abdominal Wall.* Since there is paralysis or paresis of some part of the abdominal wall in the majority of cases of paralytic scoliosis, it is important that this muscle defect be recognized early and corrected or compensated by a fascial reinforcement. This operation, easily performed and generally successful, should be done as soon after the discovery of the abdominal weakness as the condition of the patient will permit. It certainly will give the patient a sense of greater security, will facilitate the more effective use of the muscles of the chest and back, and may prevent the occurrence of a scoliosis or at least its increase if it is already present. An abdominal fascial re-

inforcement should not be employed as a last resort, for it has very little value, if any, after a severe scoliosis has been established.

## TREATMENT

The treatment of scoliosis itself involves two factors: (1) reduction of the curvature, and (2) strengthening or stabilization of the spine by a fusion operation.

*Reduction of the Curvature.* In my own practice the use of traction on the head and pelvis with the patient recumbent on a convex frame gives excellent results, results that are favorably comparable with, if not superior to, those obtained from more drastic measures such as turnbuckle jackets, and, in much less time. There are many advantages in the method of traction on a convex frame. The trunk is completely exposed and respiration is not impeded. By the use of blow bottles the amplitude of the respirations may be greatly increased, and with increased aeration of the lungs goes an improvement in the well being of the patient. The muscles of the trunk and extremities may be freely exercised. Recumbency in extension reduces the angulation of the ribs on the convex side of the curve. The flattening of the chest on the convex side is not increased, as happens almost invariably in a plaster jacket. The reduction of the curvature to the potential maximum is very rapid, and rarely more than a matter of a few weeks.

However, there are many other methods beside traction on a convex frame which will serve well in the reduction of the curve. A simple jacket applied in suspension may be very effective. A "straight" jacket applied with three point corrective pressure may certainly yield excellent improvement. Similarly, distraction jackets, segmented jackets and turnbuckle jackets may be used very effectively. Each surgeon will undoubtedly obtain the best results with the method in which he is most proficient. The important point is that the curvature should be reduced as much as possible before the spine is fused.

*Spine Fusion.* It is my impression that we have been performing spine fusions in paralytic scoliosis much too late after its recognition. Knowing that in most instances the curvature will increase, a spine fusion should be contemplated as soon as a paralytic scoliosis is discovered. The parents should be apprised of that fact, and plans should be made to do the operation as soon as the patient's general condition and the requirement of the other paralyses and deformities will permit.

*Extent of Spine Fusion.* I think that the simplest rule is to extend the fusion from the upper to the lower transitional vertebra of the improved spine in a single curve, or from the uppermost transitional vertebra to the lowermost in a compound curve. The fusion may be done in one or several stages depending upon the technic employed, and the general condition of the patient. No fusion operation should last more than one hour, because these patients tend to react poorly and develop acidosis. Particularly is this true if the operation has been accompained by much bleeding or excessive trauma. A spine fusion operation is one that requires the maximum of surgical talent. Since it necessitates the use of a certain amount of force and trauma to the tissues, the surgeon and his assistants must keep in mind not so much the administration of intravenous medication as the employment of accuracy, speed, dexterity and gentleness. Know your anatomy and treat the tissues lovingly. Subsequent to the operation the patient must be kept in bed for two to three months until the fusion is reasonably solid. The back should then be supported in a plaster jacket, a corset or a brace for several years to prevent any marked relapse. Some increase in the curve usually occurs when the patient stands up, but this can be reduced to a minimum if adequate support is maintained uninterruptedly for several years.

## CONCLUSIONS

1. The results of the treatment of paralytic scoliosis have so far been very poor with only a small percentage of successes.

2. In all cases with extensive extremity paralysis one must be on the lookout for a scoliosis. This is particularly true if there is any abdominal weakness.

3. When a scoliosis is discovered, all treatment must be directed to maintaining the trunk in a symmetrical position. This may entail prolonged rest in bed, the use of restraining cushions and sandbags, a plaster bed, a canvas corset, a celluloid corset, a spinal brace or a plaster jacket.

4. Exercises should be employed wherever possible to minimize muscle and bone atrophy.

5. If an abdominal muscle weakness is found, it should be corrected or compensated by a fascial reinforcement.

6. Deformities in the extremities, and particularly pelvic obliquity, should be corrected at the earliest possible time.

7. In all but the exceptional cases, in which the history shows that the curvature has existed for several years and has remained mild, a spine fusion operation should be performed. The operation should include all the elements of the major curves, and be followed by several months of bed rest and several years of protection and support of the back in a well fitting spinal corset or brace.

RECURRENT dislocations occur because the torn capsular ligaments have not healed, the articular surfaces being displaced easily and frequently. In most instances recurrence can be attributed to insufficient immobilization.

From "Fractures and Dislocations for Practitioners," by Edwin O. Geckeler (The Williams & Wilkins Company).

# EFFICACY OF ULTRAVIOLET BLOOD IRRADIATION THERAPY IN THE CONTROL OF STAPHYLOCOCCEMIAS*

GEORGE MILEY, M.D.
The Hahnemann Medical College and Hospital
PHILADELPHIA, PENNSYLVANIA

THE use of ultraviolet blood irradiation therapy as a safe and efficient control of acute pyogenic infections has been described by several workers in this field, notably Knott and Hancock,[1,2] Miley,[3–8] Rebbeck,[9–12] and Barrett.[13,14] Our findings have been in close agreement with the other workers, and have been reported as such with one exception, namely, the value of ultraviolet blood irradiation therapy in the treatment of staphylococcemias, in which we originally reported the failure of ultraviolet blood irradiation therapy to control the progress of staphylococcemia in seven consecutive cases. Recently, we have observed complete recovery from staphylococcemia in nine consecutive cases, and therefore wish to retract our original statement that we believed staphylococcemias did not respond well to ultraviolet blood irradiation therapy.

As the result of our original experience with seven consecutive failures, followed by nine consecutive recoveries of staphylococcemia, following ultraviolet blood irradiation therapy, we naturally wished to find some reason for the marked difference in results, and in carefully going over the records of all sixteen individuals we found that in six out of seven cases of the original failure group, intensive sulfa drug therapy had been given before and/or after ultraviolet blood irradiation therapy was administered, whereas eight of the nine individuals in the recovery group had had no sulfa drugs whatsoever, that the ninth received a small amount of sulfathiazole only, and that before the development of a positive blood culture. This finding is what might be expected after reading the report of Hancock,[2] whose eight patients suffering from septicemia received no sulfa drug therapy but recovered with ultraviolet blood irradiation therapy alone; similarly a double septicemia, reported by Rebbeck,[11] recovered following the use of ultraviolet blood irradiation therapy alone

## TECHNIC

The technic of irradiating blood used by us in this work was originally devised by Knott, and has been described in detail elsewhere.

The clinical application of ultraviolet blood irradiation therapy consists of withdrawing a predetermined amount of venous blood from an individual, citrating it and immediately returning it to the same individual through a Knott hemo-irradiator, a precision machine which automatically exposes the patient's citrated blood to ultraviolet energy safely and efficiently, and returns it immediately to the vein from which it was withdrawn.

A detailed report of results observed following the use of this method in sixteen cases of staphylococcemia follows:

## RESULTS IN STAPHYLOCOCCEMIAS

We have divided our results in staphylococcemias into two separate groups: the first consisting of seven consecutive failures of ultraviolet blood irradiation therapy to control the diseased process, six of whom received intensive sulfa drug therapy prior to irradiation, and the second consisting of nine cases of staphylococcemia, all of whom recovered following ultraviolet blood irradiation therapy alone.

* From the Blood Irradiation Clinic, Hahnemann Medical College and Hospital, Philadelphia.

TABLE I

| No. | Hospital No. | Type of Staphylococcemia | Primary Infection | Type of Sulfa Drugs Used | Number Blood Irradiations | Number of Hospitalization Days | | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | Post-Irradiation | |
| 1 | 52117 | Aureus | Staph. pneumonia, lung abscess | S* SP | 2 | 7 | 7 | D.† |
| 2 | Framingham Hosp. | Aureus | Unknown | S SP | 2 | 45 | 2 | D. |
| 3 | 65236 | Aureus and albus | Puncture wound of eye | S SP ST | 4 | 15 | 15 | D. |
| 4 | 64501 | Aureus | Prostatic resection area infection | ST | 1 | 37 | 12 | D. |
| 5 | 48830 | Aureus | Wound infection, sinus thrombosis following frontal sinusectomy | S NP | 1 | 2 | 1 | D. |
| 6 | 60720 | Aureus | Wound infection following operation for ingrown toenail | ST | 2 | 13 | 9 | D. |
| 7 | 38082 | Aureus | Bladder carcinoma, bilateral pyonephrosis, empyema, atelectasis, bronchial pneumonia | None | 4 | 47 | 18 | D. |

* Key:
S—Sulfanilamide
SP—Sulfapyridine
ST—Sulfathiazole
NP—Neoprontosil
† Died

TABLE II

| No. | Hospital No. | Type of Staphylococcemia | Primary Infection | Type of Sulfa Drugs Used | Number Blood Irradiations | Number of Hospitalization Days | | Result |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Total | Post Irradiation | |
| 1 | 81994 | Aureus | Marked erysipeloid inflammatory process of right ear | ST (before appearance of staphylococcemia) | 1 | 20 | 12 | R.* |
| 2 | 84630 | Aureus | Incomplete septic abortion | None | 1 | 16 | 11 | R. |
| 3 | 88168 | Aureus | Incomplete septic abortion | None | 2 | 19 | 16 | R. |
| 4 | 88167 | Aureus | Incomplete septic abortion | None | 1 | 10 | 9 | R. |
| 5 | 82484 | Aureus | Incomplete septic abortion | None | 1 | 20 | 7 | R. |
| 6 | 83141 | Albus | Acute ulcerative rhinitis, acute suppurative otitis media, acute mastoiditis, incomplete septic abortion | None | 2 | 39 | 17 | R. |
| 7 | 82702 | Albus | Incomplete septic abortion, putrid endometritis, parametritis, pelvic peritonitis | None | 2 | 12 | 7 | R. |
| 8 | 86768 | Aureus | Post-measles upper respiratory infection | None | 2 | 19 | 16 | R. |
| 9 | 50698 | Albus | Postcesarean pelvic thrombophlebitis | None | 1 | 33 | 11 | R. |

* Recovered

*Group I—Seven Staphylococcemias Not Controlled by Ultraviolet Blood Irradiation Therapy.* In this group six individuals received ultraviolet blood irradiation therapy following intensive sulfa drug therapy, five due to Staphylococcus aureus, and one to both Staphylococcus aureus and albus; the seventh, with Staphylococcus aureus septicemia secondary to bladder carcinoma complicated by right-sided atelectasis and empyema, received only ultraviolet blood irradiation therapy. In all seven there was a complete failure to control the staphylococcemia and all these patients died.

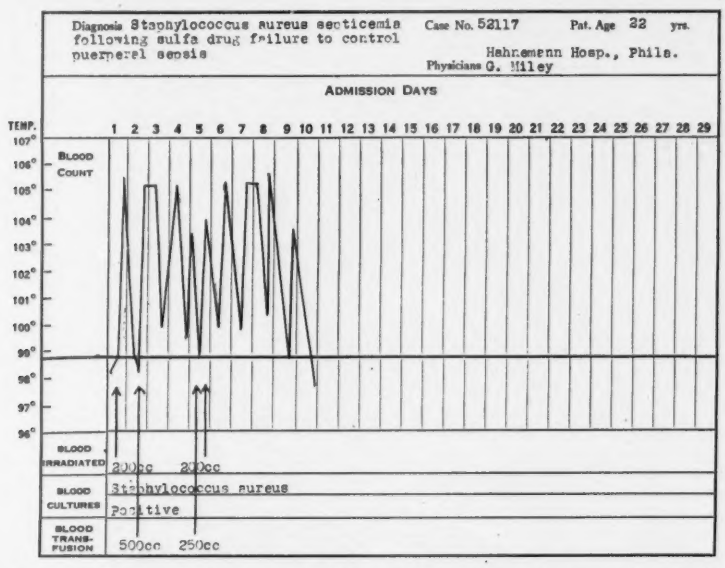


FIG. 1. (Group I.) Case 1. In this patient there developed a fulminating Staphylococcus aureus septicemia and staphylococcus pneumonia while the patient was being given intensive sulfanilamide and sulfapyridine therapy for puerperal sepsis. On transfer to this hospital ultraviolet blood irradiation therapy and whole blood transfusion failed to influence the course of the disease and the patient died.

In Table I is shown the protocol of Group One tabulating the salient features observed to occur clinically in this group.

Peak temperature graphs illustrating the absence of beneficial effects in staphylococcemias of ultraviolet blood irradiation therapy used after intensive sulfa drug therapy failed are shown in Figures 1, 2, and 3.

*Group II—Staphylococcemias Controlled by Ultraviolet Blood Irradiation Therapy.* In this group of nine staphylococcemias receiving ultraviolet blood irradiation therapy alone, six were due to Staphylococcus aureus and three to Staphylococcus albus. In all nine there was a complete control of the staphylococcemia and all nine patients recovered.

In Table II is shown the protocol of Group Two tabulating the salient features observed to occur clinically in this group.

Peak temperature graphs showing the relation of ultraviolet blood irradiation therapy to the subsidence of fever, coincident with generalized detoxification, in three of the individuals from Group Two are shown in Figures 4, 5, and 6.

## CASE REPORTS

Six case history abstracts from Group Two are presented:

CASE 1. No. 81994. The patient was admitted November 16, 1942, complaining of severe pain and swelling in the region of her right ear. Physical examination revealed a marked edematous erysipeloid inflammatory process around the right ear, and some injection of the right ear drum. Her temperature was 100.0°F., pulse rate 120, and respiratory

rate 24 at this time. Routine hematological examination and urinalysis were negative. Sulfathiazole was started, and given intensively for three days, during which time the patient's temperature rose to 103.0°F., her pulse rate to 124, and respiratory rate to 28, but finally fell to normal on November 19, 1942. The patient's erysipeloid lesion had improved, there was less injection of the ear drum, so sulfathiazole was discontinued. The patient ran an uneventful course for another three days, but on November 23rd her temperature began to rise again; this rise continued for forty-eight hours to 102.0°F.; the pulse rate rose to 110, at which time the patient suddenly became somewhat toxic. A blood culture taken at this time later proved to contain a luxuriant growth of Staphylococcus aureus. Ultraviolet blood irradiation therapy was instituted immediately after blood culture was taken. Forty-eight hours later the patient's temperature and pulse rate both fell to normal. Blood culture taken November 28, 1942, three days after blood irradiation, was sterile. The patient convalesced uneventfully, leaving the hospital on December 6, 1942, twelve days after a single blood irradiation.

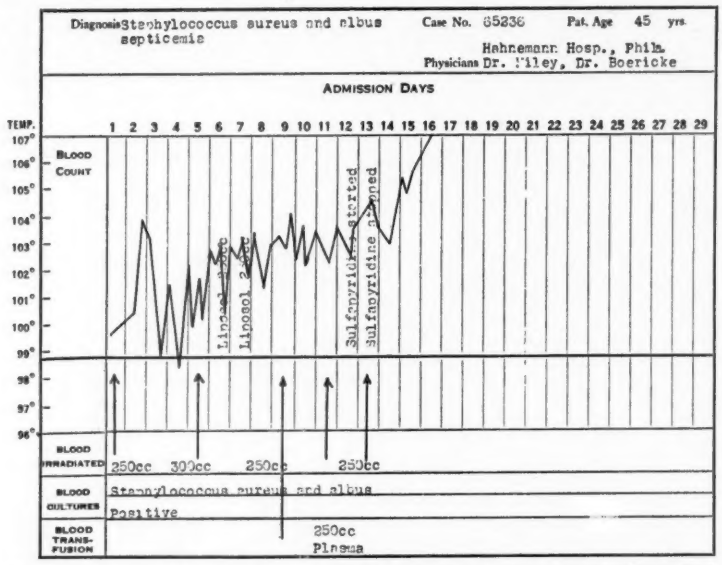


Fig. 2. (Group I.) Case III. This patient was admitted to the hospital after two weeks of intensive sulfathiazole therapy following puncture wound of the eye; a fulminating Staphylococcus aureus Staphylococcus albus septicemia developed during this period of chemotherapy, and failed to respond during hospitalization to ultraviolet blood irradiation therapy, liposol and sulfapyridine.

Case II. No. 84630. This patient was admitted March 10, 1943 to, the septic ward with a diagnosis of incomplete septic abortion which was confirmed by physical examination. Two days later the patient passed two large blood clots. The patient's temperature, which had varied from 98.0° to 99.8°F., fell to normal, and the patient was allowed out of bed. Forty-eight hours after being allowed out of bed the patient's temperature began to rise reaching 101.6°F.; her pulse rate rose to 112. The following day, March 15th, the patient became extremely toxic; her temperature rose again, this time to 103.6°F. Blood culture was taken and ultraviolet blood irradiation therapy administered. The blood culture, taken in tryptose phosphate broth, later proved to be positive with a profuse growth of pure culture Staphylococcus albus. On the first post-irradiation day, March 16th, the patient's temperature fell to normal and her toxic symptoms had almost completely disappeared. Forty-eight hours after blood irradiation the patient passed a large amount of secundines, and two days later dilatation and curettage was performed. The patient's subsequent convalescence was uneventful, blood cultures being negative thereafter, and the patient left the hospital March 26, 1942, eleven days after a single blood irradiation.

Case III. No. 88168. The patient was admitted April 14, 1943, complaining of abdominal pain and vaginal bleeding. Physical

examination on admission revealed a right-sided parametrial tenderness, normal temperature, pulse and respiratory rates. Routine normal; the patient's toxic symptoms had almost completely disappeared. On the second post-irradiation day, April 19th, 250 cc. of

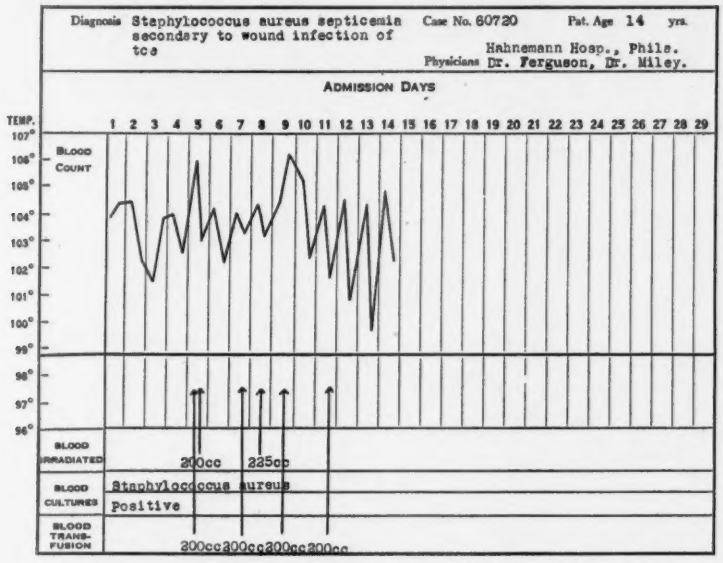


FIG. 3. (Group 1.) Case VI. This patient developed Staphylococcus aureus septicemia following removal of an ingrown toenail by a chiropodist. Intensive sulfathiazole therapy failed to control this septicemia, as did subsequent ultraviolet blood irradiation therapy and more sulfathiazole therapy with death as a final result.

hematological examination and urinalysis were negative; however, on the day following admission the patient's temperature rose to 102.0°F., her pulse rate to 104, her respiratory rate remaining normal; clinically, the patient appeared to be moderately toxic. Ultraviolet blood irradiation therapy was instituted at this time, April 15th, and a blood culture was taken in tryptose phosphate broth; this later proved to be pure culture positive for Staphylococcus aureus, with a rich golden pigmentation apparent in a subculture made on Loeffler's medium. On the following day the patient's temperature rose to 104.6°F., and she appeared more toxic than ever. Forty-eight hours after the initial ultraviolet blood irradiation the patient's condition had shown no improvement but had continued to deteriorate, and her temperature was 103.2°F. at 8 A.M., April 17th. At 9 A.M. a second blood culture was taken which was also pure culture positive for Staphylococcus aureus, which showed much less golden pigmentation in a subculture on Loeffler's medium than did the first culture. As soon as the culture was taken ultraviolet blood irradiation therapy was repeated, and within twenty-four hours following this second blood irradiation her temperature and pulse rate returned to whole blood was given. On April 20th, a piece of placental tissue was passed. A blood culture taken on April 24th was negative. On April 27th, dilatation and curettage was performed, followed by no temperature rise whatsoever. The patient continued to convalesce uneventfully, and left the hospital on May 3, 1943, in apparently excellent condition, eighteen days after her original blood irradiation. At no time during this sixteen-day convalescent period did the patient's temperature rise above 98.6°F.

CASE IV. No. 88167. This patient was admitted October 30, 1942, to the septic ward, complaining of vaginal bleeding and crampy abdominal pains of two days' duration. Physical examination revealed a bilateral parametrial tenderness, and an enlarged edematous cervix; a diagnosis of incomplete septic abortion was made. During the first twenty-four hours of hospitalization the patient had two very severe chills, her temperature ranged between 99.2° and 100.2°F., her pulse rate between 108 and 140, and her respirations between 22 and 28; the patient was extremely toxic at this time. Urinalysis was negative; erythrocyte count 3,260,000, hemoglobin 11.1 Gm., leukocyte count 14,600 with 85 per cent polymorphonuclears and 15 per cent lym-

phocytes. On the day following admission ultraviolet blood irradiation therapy was given; a blood culture taken just before the blood

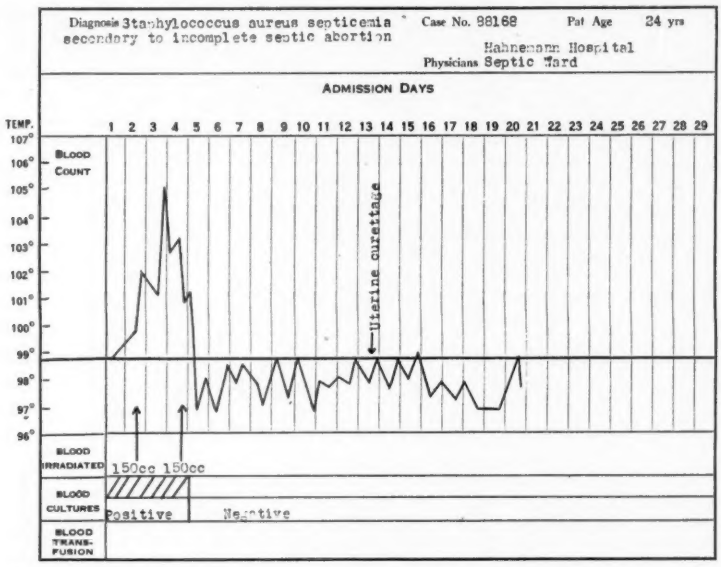


Fig. 4. (Group 2.) Case III. This patient was admitted with Staphylococcus aureus septicemia secondary to incomplete septic abortion, and failed to show any response following a single blood irradiation but within twenty-four hours after a second blood irradiation her temperature fell to normal and all her toxic symptoms disappeared, convalescence being uneventful.

irradiation later proved to be positive for Staphylococcus aureus hemolyticus. Her condition improved markedly in the first forty-eight hours following blood irradiation, as evidenced by a marked alleviation of all toxic symptoms; the erythrocyte count was now 3,470,000, hemoglobin 12.6 Gm., and leukocyte count 6,800 with 72 per cent polymorphonuclears and 28 per cent lymphocytes. Dilatation and curettage was performed at this time, November 2, 1942, obviously without knowledge that the blood culture would prove to be positive for Staphylococcus aureus. The patient's symptoms disappeared entirely following dilatation and curettage, she convalesced uneventfully, and left the hospital November 9, 1942, in apparently excellent condition, nine days after a single blood irradiation and seven days after dilatation and curettage.

Case V. No. 82484. The patient was admitted to the septic ward December 23, 1942, with the diagnosis of incomplete septic abortion complicated by severe hemorrhage. Laboratory examination revealed an erythrocyte count of 2,270,000 and a hemoglobin reading of 9 Gm.; sedimentation rate was 3 mm. and 25 mm. at 15 minutes and 45 minutes, respectively. A 500 cc. whole blood transfusion was given immediately. The patient suffered a mild transfusion chill, but at the end of forty-eight hours seemed definitely improved. Despite the transfusion, however, the patient's blood picture remained relatively unchanged, the erythrocyte count varying between 2,980,000 and 2,200,000, and the hemoglobin between 9.4 and 8.3 Gm. The patient's temperature rose daily to 99.2°F. This more or less static condition prevailed, but the sedimentation rate began to rise reaching 22 mm. and 34 mm. at 15 minutes and 45 minutes, respectively on January 2, 1943. In view of this it was believed that dilatation and curettage was necessary. Preoperative ultraviolet blood irradiation therapy was given January 5th; blood culture taken at this time later proved to be positive for Staphylococcus aureus hemolyticus. Dilatation and curettage was performed on the day following blood irradiation, January 6th, at which time no knowledge of the positive blood culture had been obtained. The patient convalesced uneventfully from this point on, and left the hospital January 12, 1943, in apparently excellent condition, seven days after blood irradiation and six days after dilatation and curettage done within twenty-four hours

of the time that a positive blood culture had been present.

It is my opinion that this again illustrates the powerful protective effect that one can expect from ultraviolet blood irradiation therapy, since one would expect a patient receiving uterine curettage, while bacteria were still present in the blood stream, to undergo a relatively stormy course, and not to be discharged in good condition within a week's time as was this fortunate patient.

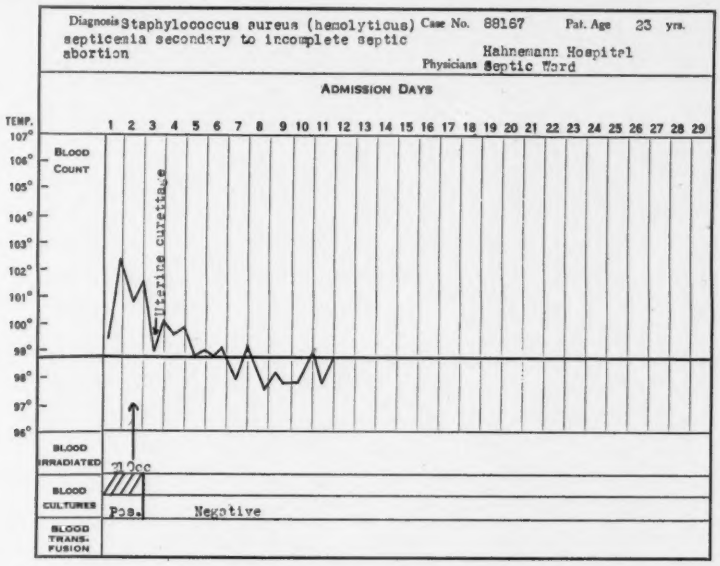


FIG. 5. (Group 2.) Case IV. This patient received ultraviolet blood irradiation therapy plus uterine curettage the following day without knowledge that the blood stream was positive for Staphylococcus aureus in pure culture. Subsequent cultures were negative. The patient convalesced uneventfully.

CASE VI. No. 83141. This patient was admitted to Hahnemann Hospital January 15, 1943, complaining of severe nose bleed and persistent fever. Physical examination revealed an acute ulcerative rhinitis, and an acute suppurative otitis media, associated with a pregnancy of two months' duration; temperature was 100.2°F., pulse rate 128, respiratory rate 24. Laboratory findings were essentially negative. Her nasal hemorrhage was easily controlled by nasal packing, but the acute otitis media increased in severity in the amount of copious purulent discharge. On January 19th, the patient began to complain of a throbbing sensation in the affected ear. Although her temperature had dropped to a level of 99.0°F., the patient's general condition had continued to deteriorate slowly, and on January 23rd obstetrical consultation revealed the imminence of a threatened abortion. On January 26th, drainage from the ear had entirely stopped, and the mastoid process had become extremely tender. Ultraviolet blood irradiation therapy was instituted, and blood culture taken at this time proved to be positive for pure culture of Staphylococcus albus. The patient's toxic symptoms, which had been increasing rapidly, began to subside slowly, but her temperature remained elevated ranging between 98.0° and 100.8°F. Increasing signs of acute mastoiditis became apparent and on February 2nd radical mastoidectomy was performed. Blood culture taken shortly afterward showed the presence of Streptococcus hemolyticus, which was believed to be a transient bacteremia following mastoidectomy. The patient's condition continued to deteriorate slowly despite mastoidectomy, and uterine dilatation and curettage was recommended, since blood cultures taken on February 4th and 5th proved to be sterile. Ultraviolet blood irradiation therapy was repeated followed by uterine dilatation and curettage later the same day. The patient's toxic symptoms began to subside rapidly, and at the end of forty-eight hours she appeared definitely improved for the first time during her hospitalization. Blood culture taken February 8th was sterile. The

patient convalesced uneventfully, her temperature slowly falling to normal, and she left the hospital in apparently excellent condition February 23, 1943.

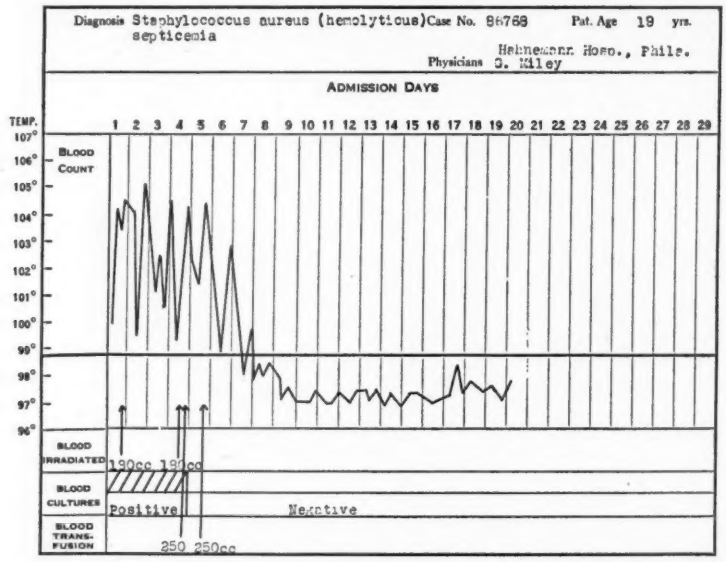


FIG. 6. (Group 2.) Case VIII. This patient, a student nurse, was given ultraviolet blood irradiation therapy initially to control what we believed to be an acute influenzal pneumonitis following measles. It was not until after a second blood irradiation was given that blood culture taken on admission proved positive for Staphylococcus aureus, as did a second blood culture taken just before the second blood irradiation. Forty-eight hours after the second blood irradiation the patient's toxic symptoms began to subside, blood cultures became sterile, and her temperature dropped to normal with subsequent uneventful recovery.

## CLINICAL OBSERVATIONS

The recovery of nine individuals with staphylococcemia receiving ultraviolet blood irradiation therapy alone was certainly the opposite from the results observed in the seven individuals who also were suffering from staphylococcemia but who died despite ultraviolet blood irradiation therapy given after or along with intensive sulfa drug therapy. The chief difference between the two groups receiving ultraviolet blood irradiation therapy is obviously the use of the sulfa drugs in the group that died.

In the recovery group there occurred the same sequence of events already reported to occur in other acute pyogenic infections.[2,3,7,11] These are briefly (1) a marked detoxification effect manifested by a pronounced subsidence of toxic symptoms, such as nausea, vomiting, delirium, fever, general malaise, high pulse and respiratory rates, and mental confusion; (2) a complete disappearance of the invading bacterial organism; (3) grossly discernible peripheral vasodilation, and (4) a complete absence of deleterious effects.

Apparently the use of sulfa drugs so greatly lowered the resistance of the individuals in Group One that ultraviolet blood irradiation therapy was no longer able to be of any benefit to these patients. This may possibly be due to the fact that once sulfa drugs fail to control an infection one encounters all the ill effects of a toxic drug, producing generalized tissue anoxia, superimposed upon the toxic products of bacterial growth and decomposition. In any event, it is our opinion that the use of the sulfa drugs in the cases of staphylococcemias seen by us has had no beneficial effect whatsoever, but on the contrary has so seriously lowered the individual

patient's resistance that recovery was made impossible, even after receiving ultraviolet blood irradiation therapy, a therapy which in Group Two has been found to yield encouraging results in staphylococcemias not complicated by the use of sulfa drugs, which are rather generally known to have little or no effects on most staphylococcemias.

## SUMMARY

There has been presented a report and analysis of sixteen cases of staphylococcemia given ultraviolet blood irradiation therapy as a method of controlling this type of acute pyogenic infection.

The first seven staphylococcemic individuals treated by ultraviolet blood irradiation therapy failed to respond and died. Six of these seven received intensive sulfa drug therapy, whereas the seventh, whose staphylococcemia arose from a bladder carcinoma and was complicated by atelectasis and empyema at the time of institution of ultraviolet blood irradiation therapy, received only blood irradiation and also died.

The results of ultraviolet blood irradiation therapy in a second group of nine consecutive staphylococcemic individuals given blood irradiation was reported; all nine of these individuals recovered uneventfully; eight of the nine received no sulfa drugs whatsoever, and the ninth, forty-eight hours of sulfathiazole therapy one week before blood culture became positive.

In each of the sixteen cases reported one or more pure cultures of pathogenic strains of either Staphylococcus aureus or Staphylococcus albus were obtained from blood cultures taken in tryptose phosphate broth.

In fifteen of the sixteen cases there was present a profound toxemia at the time of institution of ultraviolet blood irradiation therapy.

Uterine dilatation and curettage was performed in three individuals of Group Two, the recovery group, while the blood culture in each of the three individuals was still positive. No untoward effects were observed to follow this radical procedure performed despite the presence of staphylococci in the blood stream.

## CONCLUSION

1. The apparently paradoxical recovery following ultraviolet blood irradiation therapy in nine consecutive cases of staphylococcemia, after its original reported failure to control acute pyogenic infection in the first seven cases of staphylococcemia we treated, can be attributed to the fact that sulfa drugs were used intensively in six of the seven failures, and that ultraviolet blood irradiation therapy alone was used in the nine individuals recovering from staphylococcemia following ultraviolet blood irradiation therapy.

2. It is our opinion that sulfa drugs are contraindicated in most cases of staphylococcemia.

3. Ultraviolet blood irradiation therapy alone has proved to be a successful method of controlling the acute pyogenic infection in nine consecutive cases of staphylococcemia.

4. The earlier ultraviolet blood irradiation therapy is applied in any acute pyogenic infection, including staphylococcemias, the better are the chances of recovery.

5. The use of sulfa drugs in six cases of staphylococcemia appeared to lower the resistance of each of these patients so severely that the use of ultraviolet blood irradiation therapy, successful when used alone in nine consecutive cases of staphylococcemia, was no longer able to control the staphylococcemia.

6. We must retract our original statement that ultraviolet blood irradiation therapy has little or no effect upon staphylococcemias, and admit that, when used alone, this procedure has been successful in controlling staphylococcemia, at least in nine consecutive cases.

7. Finally, the use of ultraviolet blood irradiation therapy is preferable to the use of sulfa drugs in the treatment of staphylococcemias.

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# SYNERGISTIC MIXTURE OF AZOCHLORAMID, UREA AND SULFANILAMIDE*

## EXPERIMENTAL AND CLINICAL STUDY

JAMES A. DINGWALL, III, M.D.
Surgical Fellow, New York Hospital
NEW YORK, NEW YORK

CHEMOTHERAPEUTIC agents are known to depend to a great extent upon the natural cellular and humoral defenses of the infected host for their ultimate effects, hence the value of the topical administration of sulfonamides has been questioned by some. From the work of Fourneau, Trefouël, Trefouël, Nitti, and Bovet,[1] Colebrook,[2] and others, we know, however, that sulfonamides act directly on bacteria by inhibiting their growth. For this reason, and also because the cellular defense, i.e., phagocytosis, is known to participate actively in the cleaning of wound infections, topical application of sulfonamides seems to be justified. The results obtained in the prevention of wound infection have been remarkably good. The effects observed when grossly infected wounds were treated with sulfonamides were not as favorable. This is usually attributed to the presence of large amounts of sulfonamide inhibitors in wounds containing pus and tissue débris (Lockwood[3]). *In vitro* experiments have shown that the concentration of sulfonamide necessary to inhibit growth depends on the size of inoculum, consequently sulfonamides are rather ineffective when used on wounds containing pockets of pus which harbor a large number of bacteria.

The problem of decreasing the size of inoculum and destroying the sulfonamide inhibitors has attracted the interest of many investigators recently. In an attempt to analyze the good results which Goldberger[4] obtained using a combination of azochloramid, a chloramine disinfectant, with sulfanilamide on infected wounds, Neter,[5,6] and Schmelkes and Wyss[7] investigated the effect of this combination *in vitro*. They found that the addition of small amounts of azochloramid, which alone failed to prevent growth of Bacillus coli, to a solution of sulfanilamide which also was ineffective in inhibiting the growth of bacteria resulted in a mixture which prevented growth completely. The effect appeared to be much more than additive. Schmelkes and Wyss attributed this effect of azochloramid to its destructive action on p-aminobenzoic acid, the most notorious sulfonamide inhibitor. The destruction of p-aminobenzoic acid may be due to its oxidation or chlorination by azochloramid. In this connection it is of interest that recently Wyss, Rubin, and Strandskov[8] have shown that some chlorine derivatives of p-aminobenzoic acid are not only inactive as growth promoters but are actually potent growth inhibitors. Azochloramid also reduces the extent of contamination, that is, the number of bacteria present in the wound. The possibility that azochloramid oxidizes some of the sulfonamides and produces small amounts of a highly active agent cannot be entirely disregarded.

Recently, Clark[9,10] and his co-workers have demonstrated another method of sensitization of bacteria to sulfonamides. They found that in synthetic media 1.25 to 1.75 per cent urea enhances the action of sulfonamides considerably and also that organisms resistant to sulfonamide

* From the Department of Surgery, New York Hospital and Cornell University Medical College, New York.

become sensitive to this drug in the presence of urea. Holder and MacKay[11,12] among others have used urea and sulfonamide combinations clinically with good results.

Another interesting finding which is of great importance in the practical application of sulfonamides is the enhancing effect that increasing of the hydrogen ion concentration has on the antibacterial action of sulfonamides. The magnitude of this effect and the hydrogen ion concentration range in which it can be observed varies with different sulfonamides. It increases as the acidity (dissociation constant) of the sulfonamide decreases. Thus among the most important sulfonamides it is the greatest with sulfanilamide,[13,14,15]. At a hydrogen ion concentration of 9, which is close to the highest concentration with which tissue repair is compatible, sulfanilamide is as active as sulfathiazole or sulfadiazine if equal concentrations are compared. Sulfanilamide is, however, very much more soluble and in saturated solutions it at least equals the activity of the above mentioned sulfonamides even at a hydrogen ion concentration of about 8.

The consequent advantages to be incurred by the application of the described findings to local chemotherapy are obvious. Both compounds, azochloramid and urea, which enhance the activity of sulfonamides *in vitro* have been used extensively in the treatment of wounds as an aid to surgery. Azochloramid has been shown recently by Welch, Slocum and Hunter,[16] Salle, McOmie, Shechmeister, and Foord,[17] Hirsch and Novak,[18] to be one of the disinfectants with a very small toxicity index.

In view of the sound rationale and the encouraging results of a few sporadic trials with a 10 per cent suspension of sulfanilamide in a solution of azochloramid in triacetin (1 :500) in the course of the past two years, it was decided to test a preparation in which sulfonamide was combined with a small amount of azochloramid, urea, and a buffer mixture. In addition to these constituents a small amount of wetting agent was also added to the preparation* to insure even distribution and better penetration of the active ingredients. This product was prepared in the form of a stable powder suitable for application to wounds and which had a particle size between 40 and 80 mesh. The composition of the preparation is as follows: 9.5 per cent urea, 5.0 per cent disodium phosphate, 75 per cent sulfanilamide, 10 per cent calcium carbonate, 0.1 per cent azochloramid, 0.2 per cent granulating agent, 0.2 per cent sodium tetradecyl sulfate.

Control powders used in this study were: Buffered sulfanilamide containing 90 per cent sulfanilamide and 10 per cent calcium carbonate, and a powder which contained the azochloramid and sulfanilamide but did not contain either calcium carbonate or urea.

*Experimental Use.* Before application of this powder to human lesions, animal experiments were conducted to test the local toxic effects of the drug.

The following experiments were carried out: Male rabbits of approximately 3,200 Gm. weight were used. The skin of the back was shaved and prepared for operation by the application of iodine and alcohol, and the area draped with sterile towels. An incision approximately 2.5 cm. in length was made paravertebrally at a site about one inch below the twelfth rib. In succession, the superficial and deep fascia were incised exposing the sheath of the lumbar group of muscles. This fascial covering was then opened and the muscle fibers split bluntly so as to form a cavity, into which was placed from 1 to 2 Gm. of the composite powder. The wound was then closed in layers with interrupted silk sutures, another 1 Gm. of powder being implanted directly under the skin. Exactly the same procedure

* Acknowledgement is due to the Research Department of Wallace & Tiernan Products, Inc., Belleville, New Jersey, for generous supply of the combinations of Azochloramid and sulfanilamide (AZOCHLORASUL).

was carried out on the opposite side using the same amount of suture material, but no drug was placed into either the muscle or subcutaneous tissue.

At the close of each operation as much powder was insufflated into one eye as was necessary to fill the socket space and cover the globe.

Subsequently, contralateral sides were biopsied from two to ten days following implantation and the tissue examined microscopically. No difference was noted in the treated and untreated side. In none of the animals used was there evidence of the presence of drug in their eyes, nor was there any suggestion of inflammatory reaction after twenty-four hours.

In a second group of experiments, ten full grown rats (250 Gm.) were anesthetized and an incision of approximately 1 to 2 cm. was made in the midline, opening into the peritoneal cavity. Approximately 50 mg. of the powder was applied in this area, and the wound was closed with silk. Subsequently, two animals were sacrificed at each one, two, four, seven and fourteen-day interval and the viscera examined microscopically. Sections showed no evidence of parenchymal damage, although in the fourteen-day rats there was some fibroplasia in the mesentery and splenic capsule.

*Clinical Use.* Due to the absence of any untoward effects attributable to the combination when used on fresh wounds and on sensitive mucous membranes it seemed justifiable to use it in a small series of cases of localized pyogenic infections in humans.

Work was conducted in an active surgical out-patient department using ambulatory patients. Prior to the use of this combination sulfanilamide buffered with calcium carbonate was used in granulating wounds. Good results have been reported recently by Scott[19] in primary closure following excision of potentially contaminated pilonidal sinuses on the use of this preparation. It was apparent, however, after ten patients with infected lesions had been treated that sulfanilamide, even though buffered, was of little value in cleaning up these wounds and promoting healing. This was presumably due to the presence of pus and necrotic débris containing sulfonamide inhibitors. In these wounds, sulfanilamide appeared to retard rather than accelerate the ultimate healing, even though the actual hydrogen ion concentration of the wound itself could be kept between 6.5 and 7.8.*

In a second series of twenty-five cases the combination described above containing urea and azochloramid was used as the only form of definitive therapy. The powder was applied to infected open lesions and patients were redressed at unusually infrequent intervals. The lesions were generally of the chronic type of infected wounds which often require clinic treatment for weeks and months. The patients were for the most part unimaginative and abhorred any form of home therapy, relying on occasional clinic visits for all treatment.

In order to save space treatment and results are given in the Table on page 326 in an abbreviated form (Table 1).

It is realized that the series is neither sufficiently homogenous nor sufficiently large to allow statistical comparison with a similar series treated with other methods of therapy. The results given in the chart indicate, however, that the combination is worthy of serious consideration and it may prove upon subsequent investigation to be a valuable aid in the treatment of infected lesions. Recently Long[20] and Crile[21] have reported on goods results obtained by the simultaneous application of azochloramid and sulfanilamide. Our small series with a preparation based on the same rationale appears to corroborate their results.

It was attempted to obtain the impartial opinion of some physicians, whose comments should be fairly reliable because of

* Hydrogen ion concentration determinations were carried out with a small glass electrode.

TABLE I

| Patient | Age | Type of Lesion | Healing Time Days | Interval of Treatments | Remarks and Previous Treatment | Cultural Findings |
|---|---|---|---|---|---|---|
| H. N. | 24 | Avulsion of skin, 42 cm. | 39 | q. 3 d. | Primary suture broke down | |
| G. M. | 2 | Infected 2nd degree burn | 6 | q. 2 d. | Debridement | |
| T. M. | 13 | Carbuncle, 3 × 2 cm. | 19 | q. d.-q. 2 d. | Incision and drainage | Staphylococcus aureus hemolyticus |
| J. L. | 48 | Infection due to x-ray defect | 65 | q. 3–4 d. | With involvement of lacrimal bone | |
| F. J. | 32 | Infection around tube graft | 16 | q. 2 d. | Tube graft took | Staphylococcus aureus hemolyticus and non-hemolyticus |
| G. H. | 60 | Paronychia 2nd toe with ulcer | 18 | q. 3–4 d. | Poor peripheral circulation due to arteriosclerosis | Staphylococcus aureus |
| P. H. | 40 | Trophic ulcer over tibia | 12 | q. 3–4 d. | | |
| H. H. | 18 | Abscess of middle finger | 38 | q. ld-q. 2 d. | Incision and drainage twice | Staphylococcus aureus hemolyticus |
| E. D. | 29 | Axillary abscess, 4 × 2 cm. | 12 | q. d. | Incision and drainage | Staphylococcus aureus hemolyticus |
| E. D. | 32 | Traumatic amputation of finger, failure of free graft, infection | 60 | q. 2-q. 3 d. | Primary closure with graft; no take—infection | Staphylococcus albus, nonhemolyticus; diphtheroid bacillus |
| C. D. | 56 | Diabetic gangrene of foot | 120 | q. 3–4 d. | Diabetes controlled, no amputation necessary | |
| J. D. | 19 | Osteo. sinus shin | 40 | q. 3–4 d. | | |
| A. C. | 69 | Old 2nd degree burn | 28 | q. 5 d. | ..... | Staphylococcus aureus hemolyticus |
| T. C. | 18 | Axillary abscess | 90 | q. 2–3 d. | Incision and drainage had repeated recurrent pockets | Staphylococcus aureus hemolyticus |
| M. B. | 13 | Felon | 48 | q. 2 d. | Incision and drainage | |
| K. A. | 30 | Infection of finger | 26 | q. 2 d. | Followed excision of xanthoma | |
| G. P. | 32 | Infected sebaceous cyst | 10 | q. 2–3 d. | Incision and drainage | |
| M. O. | 82 | Varicose ulcer, 4 cm. | 92 | q. 4–5 d. | Failure of improvement with Unna boot. Ace bandage | |
| H. R. | 19 | Avulsion of skin of finger, 1 cm. | 5 | q. 2 d. | Debridement | Staphylococcus aureus hemolyticus |
| S. R. | 51 | Carbuncle of neck | ... | q. d. | Incision and drainage; patient lost to clinic | |
| F. S. | 16 | Infected pilonidal sinus | 10 | q. 4 d. | Improved but not healed | |
| W. W. | 52 | Varicose ulcer, 2.5 cm. | 38 | q. 4 d. | Nearly healed—boot failed to improve | |
| M. N. | 13 | Abscess of arm, 5 cm. | 15 | q. 3 d. | Incision and drainage | Staphylococcus aureus hemolyticus |
| M. F. | 66 | Varicose ulcer | 10 | q. 2 d. | Ulcer not healed but clean for boot | Staphylococcus aureus hemolyticus |
| M. M. | 70 | Varicose ulcer | 16 | q. 3 d. | Ulcer not healed but clean for boot | |

the generally healthy skepticism with which all "new drugs" are treated by them. Their notes on the patients' charts can be summarized as follows:

I. It was universally agreed that wounds "cleaned up quickly." By this it was meant that healthy, clean granulations were obtained in a shorter period of time than in cases in which occasional dakinization, bland ointment, or pure sulfonamide powder or paste was used.

II. The interval between clinic visits was long, the number fewer and the time devoted to treatment was minimal.

III. There was no evidence of tissue injury, nor was there caking of the powder in the wounds. No subjective complaints were recorded. Sulfanilamide levels taken in a few instances were reported from a trace to 1 mg. per cent.

A few patients have been treated so far with a control powder without buffer and urea. This powder also appeared to produce satisfactory results suggesting that the essential merit of the combination is that of the simultaneous action of azochloramid and sulfanilamide.

## SUMMARY

A wound dusting powder having as its main constituents sulfanilamide, azochloramid, urea, and buffer has been investigated. It exhibited no apparent tissue toxicity in experimental animals and in a small series of clinical cases. Results obtained in twenty-five cases of infected lesions showed that the preparation has definite merits.

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# OSTEOCHONDRITIS DISSECANS

MAJOR GEORGE H. STEIN,
MEDICAL CORPS, ARMY OF THE UNITED STATES

MAJOR R. G. IKINS
MEDICAL CORPS, ARMY OF THE UNITED STATES

AND

CAPTAIN FREDERICK C. LOWRY
MEDICAL CORPS, ARMY OF THE UNITED STATES

THE term, *osteochondritis dissecans*, coined by Konig in 1905, refers to an osseocartilaginous lesion of debatable etiology, characterized by a partial or complete demarcation of a segment of articular cartilage and subchondral bone, with or without ultimate detachment and extrusion into the joint. The condition has been reported in the knee, elbow, hip, ankle, shoulder and metatarsophalangeal joints, as well as in the patella, the carpal scaphoid or carpal semilunar, the tibia, the head of the radius, the os calcis, the acetabulum and the lumbar vertebrae.

According to Liebman and Iseman, there are three stages in which the osteochondritic focus may be found. When retained in the original bone cavity, the articular surface is convex and covered with hyaline cartilage, whereas the deep surface will be rough and covered with fibrocartilage. When loose in the joint, the bodies tend to become rounded and may grow by accretion of new bone. The hyaline layer usually changes into fibrocartilage and the separated body may break up into numerous smaller fragments. Sometimes a free body becomes attached to synovial villi, thus forming a pedicle. When this occurs, rapid proliferation and enlargement of bone and cartilage take place.

The microscopic findings of excised specimens have been reported either as chronic inflammation or aseptic necrosis. However, inflammatory changes have not been demonstrated by the majority of investigators. The degree of necrosis varies inversely with the degree of detachment, according to the above classification. The defect in the bone may remain, or it may fill in slowly after complete separation has taken place.

The following table illustrates the characteristic locations of the condition as reported in the various bones and joints:

| Site | Characteristic Location |
|---|---|
| Knee | The lateral aspect of the medial condyle of the femur |
| Elbow | The capitellar epiphysis of the humerus |
| Hip | The superior and lateral aspect of the articular surface of the femoral head |
| Ankle | The superior and medial angle of the articular surface of the astragalus |
| Shoulder | The articular surface of the head of the humerus |
| Metatarsal bone | The articular and distal end |

Only isolated cases have been reported in the other bones mentioned above. The condition has also been reported bilaterally.

## INCIDENCE

Osteochondritis dissecans is mainly a disease affecting young adults, with a marked predominance in males. The occurrence is probably more frequent than is normally suspected. Approximately 85 per cent of reported cases involve the knee joint.

## ETIOLOGY

This condition has been divided broadly into traumatic and non-traumatic etio-

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logical factors. Wagoner and Cohn, in their definitive review of the literature, mention heredity as another possibility.

Early authors were convinced that trauma from the outside is the direct causative agent in the formation of loose bodies. Both Kragelund and Paget, however, held that it was impossible for a mere blow to detach a cartilaginous fragment, but the sequestrum could result from trauma followed by a chronic inflammatory process. Axhausen postulated "that as a result of impaction from the opposing articular surface, the blood vessels to the part are damaged, either with or without partial fracture, according to the severity of the violence. This leads to necrosis of the area supplied by the damaged vessels and as a result there forms a zone of absorption resulting in gradual separation and eventual extrusion of the dead portion of the articular surface into the joint."

Other theories include the possibilities of a subchondral impression fracture, a pull of the posterior cruciate ligament (experimentally proved impossible), an impaction of the tibial spine on the intercondyloid ridge, or tangential and rotating forces acting on the convex condylar surfaces and fissures and partially or completely detaching portions of the articular ends.

Of the non-traumatic theories, that of embolism is most frequently presented. According to Conway, " . . . first, mycotic-embolic closure of an epiphyseal artery may lead rapidly to epiphyseal necrosis; secondly, . . . the bacteria deposited may be vanquished by the body so that an infection does not take place and the necrosis remains aseptic. Thirdly, the joint bodies may develop *in situ;* therefore, from the aseptic epiphyseal necrosis by a process of demarcation. Although the epiphyseal arteries are not terminal arteries in the anatomical sense, inasmuch as fine lateral connections may be demonstrated, still the anatomical findings do not prove that the functional capacity of these fine connections is sufficient to insure nutrition of the epiphyseal region following closure of the chief arterial trunk."

Knaggs believes that the lesion is primarily a periostitis due to a very mild type of micro-organic infection, probably staphylococcic. Since this infection has only a feeble virulence, the invasion of the surface of the bone is limited, failing to penetrate the surface of the compact bone deeply. Compression of the vessels and interference with the blood supply of the compact bone in its deeper parts is caused by granulation tissues developing under the periosteum and in the Haversian canals of the superficial layers. The nutrient canal must also be invaded before necrosis will take place and curtail the supply of blood to the medulla, thus rendering the circulation within the bone unequal to the demands.

Kappis offers the explanation of a constitutional disturbance involving the bone, presupposing a congenital excessive brittleness in the epiphyseal bone, in cases in which severe injury was absent.

The concensus is that the traumatic theories are the more reasonable. The condition usually occurs in age groups more often subjected to trauma. Another factor is the absolute lack of suppuration. No gross or microscopic inflammatory changes are to be observed in or about the lesion. Conway reports that cultures prepared from excised tissue, taken from the synovial membrane lining the joint as well as from the site of the lesion, invariably display no signs of growth. Nor has bacteria ever been discovered in specimens of the joint fluid.

Even though a history of trauma is not the rule in most reports, there is still the possibility that a fracture of the articular surface may have occurred with little or no pain, since the articular cartilage does not contain a nerve supply and little sensation is felt in the cancellous bone underneath.

Conway concludes with this statement: "The most logical explanation seems to be that which allows for a preliminary

trauma to a non-sensitive articular surface with subsequent injury to a functional end-artery. Following the vessel damage and thrombosis, a localized area of necrosis results with sequestration of a fragment from the articular surface."

## SYMPTOMATOLOGY

The symptoms referable to the knee depend upon the degree of pathological change present and whether or not the osteochondritic focus is attached or free in the joint. In the early stages there may be merely indefinite symptoms with various degrees of dysfunction. Some pain is usually present following excessive movement or exercise. The knee itself becomes weak or unstable, and tenderness may be observed over the joint area.

In a clinical study of twenty-four cases, Don King divided them into three well defined groups, as follows: (1) Patients whose symptoms were markedly severe shortly following slight trauma, but without a previous history of disability; (2) asymptomatic cases, discovered by routine examinations of supposedly normal knees, *x*-rays taken mainly for comparative purposes; these were designated as "slumbering" cases; (3) cases presenting a history of definite trauma or of a "chronically troublesome knee joint" for several years, with recurrent sudden "lockings" of the joint upon extension. In some cases the loose body could even be palpated. In every case, though, the *x*-ray findings were the decisive factor in establishing the diagnosis. This group embraced the majority of cases in King's report.

Fluid in the joint is not an uncommon finding in long standing cases with synovial membrane involvement.

In general, pain, weakness and disturbance of function are the most common findings in osteochondritis dissecans involving joints other than the knee. Of particular importance in the early cases is pain brought on after prolonged standing, walking or exercising. Wasting of soft tissue is a later sign.

## RADIOLOGICAL APPEARANCES

Burr describes it as follows: "The lesion is seen as a sharply defined shallow depression, irregularly ovoid in outline, containing in its centre a button of bone, the density of which may vary from that of a fully separated sequestrum to one differing so slightly from the normal bone about it as to escape entirely any but the most careful search. Various degrees of development may be observed, from those cases which are examined during the early stage of the disease to those in which the process is fully established. In the early stage the dissecting line may fade out at one border of the lesion, leaving a hinge to connect the separating fragment of bone and cartilage to the parent bone. In these cases there is practically no change in the density of the bone lying in the loosened fragment. When the condition is more advanced and separation is complete, so that the fragment simply lies unattached in the pocket in the femur, the bone may have the density of a sequestrum and is then most readily detected in the roentgen film. At a later stage the fragment becomes separated and lies as a loose body, first in the intercondylar notch of the knee and then in any situation to which it is forced by movement. A film made at this time will show the pond-like depression in the articular surface and a loose body somewhere in the joint."

In long standing cases, with the osteochondritic focus extruded into the joint cavity, a slight osteoporotic area may be visualized in the femoral condyle, localizing the source of the joint body.

The anteroposterior projection is the most commonly employed, but excellent visualization of the lesion may also be obtained in the lateral view with separation of the condyles to avoid overlapping. Stereoscopic films and "coned" views are of additional value in identification of the lesion.

Serial study, taken at monthly intervals, is especially valuable to follow the development of the condition. Tomography is

helpful in cases in which the condition is suspected but cannot be visualized by conventional radiography.

### DIFFERENTIAL DIAGNOSIS

Free bodies within the joints other than osteochondritis dissecans are grouped under the common heading of corpora libera articulorum, or "joint mice." Wagoner and Cohn group them as follows:

1. Free bodies of traumatic origin may arise in otherwise normal joints. Cartilaginous or bony "mice" occasionally follow severe trauma to the bones comprising a joint. Pieces of normal cartilage or bone may be torn loose and appear free within the joint. An example is found in fractures of the semilunar cartilages. Severe trauma to the joints is frequently followed by periarticular formation of bone.

2. Free bodies may appear in joints that are the site of arthritis deformans. These bodies arise by the traumatic or necrotic freeing of articular cartilaginous plaques, hypertrophic bony spurs, bony joint papillae, metaplastic cartilage or hypertrophic fibrinous synovial villi. These bodies usually are present in large numbers, varying greatly in size, and frequently presenting a mulberry-like surface.

3. The polypoid bodies present in the hypertrophic type of arthropathic tabethique (incorrectly known as Charcot's joint) present the same general etiology noted for free bodies appearing in the joints in arthritis deformans.

4. Masses of uric acid salts of various sizes, usually sodium biurate, are frequently found free within gouty joints.

5. Osteomyelitis sequestrums occasionally appear within a joint.

6. Parts of tumors of the capsule in chondromatosis of a joint sometimes are found free within a joint.

7. Fibrous or lipomatous joint papillae (lipoma arborescens) occasionally become loosened and form free bodies in the joints.

8. Parts of hypertrophic synovial villi following a synovitis may be severed from their base by trauma or necrosis and appear within the joint as free bodies. When these villi or papillae contain cartilaginous foci or "rests," the process becomes known as "synovitis prolifera cartilaginea."

9. Corpora oryzoida (rice bodies) arise as a result of turberculous involvement of the structures adjacent to a joint. They are numerous, and their structures are those of fibrinoid lamellated masses.

10. Following hemorrhage into, or inflammation of, a joint, masses of fibrin may result and lay free within the joint.

11. Foreign bodies from external sources may become lodged within the joint.

Osteochondritis dissecans is differentiated from tuberculosis of the knee by the following criteria, according to Liebman and Iseman: (1) Tuberculosis tends to have severer symptoms. (2) The tuberculous joint has a generally obscured appearance on the roentgenogram, unlike that of a true osteochondritis dissecans. (3) There is usually a much greater degree of atrophy in tuberculosis. (4) The location of the process is different. In osteochondritis dissecans the areas of the articular surface which have the most contact are involved, while in tuberculosis there is early destruction of areas in which there is little or no contact. (5) Sequestration in tuberculosis shows a sequestrum of increased density which preserves its line of articular cortex, while the surrounding bone is relatively atrophic and the articular cortex indefinite or destroyed. In osteochondritis dissecans, the articular cortex is intact except in the sequestrated area, and the latter is of a similar or less degree of density than the adjacent bone.

In the case of a torn medial meniscus, the history and lack of characteristic roentgenographic changes should eliminate osteochondritis dissecans.

Hemophilic joints may at times show multiple, punched-out areas, usually involving more than one joint. The clinical course of acute febrile episodes following trauma, multiplicity of the lesions and

evidence of the disease elsewhere should serve to differentiate the two conditions.

The defects of skeletal tophi in gout are uncommon in large joints and they are rarely centrally located. The age incidence, too, is distinctly different.

## TREATMENT

In osteochondritis dissecans of the knee, ankle or elbow joint, treatment is either conservative or surgical. Kilfoy reported almost 100 per cent restoration of function in most cases in which loose bodies were excised. He suggested though that the patient be warned of the possibility of a recurrence.

Radical operations resulted satisfactorily for 88 per cent of the cases reviewed by King. He advised conservative treatment, however, for "slumbering" cases, since spontaneous healing was observed in such cases. Cases of long duration with arthritic involvement and many free bodies, according to King, are not cured by operation, for many of the symptoms are due to the accompanying synovitis.

On the other hand, Fairbank states that in the presence of symptoms, the joint should always be explored. An attempt should also be made to determine whether the overlying cartilage is movable or not. If it is, excision of the bone and cartilage is advised. If the cartilage does not move over the bone, the determining factor is the exact condition of the cartilage within the circumference of the lesion. If the cartilage is fractured, but an unbroken portion is holding the fragment in place, the fragment should be removed. Fairbanks does not advise curetting or otherwise treating the floor, since there is no object in making the crater deeper. The margins of the cartilage, and not the bone, are involved in the filling in process. In all cases, though, the semilunar cartilage should be examined for possible lesions.

Arthrotomy with the removal of the loose fragments is the only procedure, according to Conway. If done soon after the diagnosis, synovitis and traumatic arthritis will have less chance to develop.

Burr claims, too, that conservative treatment is useless in any case, as healing without surgery is rare. Concerning curetting the cavity at operation, Burr believes that even though differences in opinion do exist, complete restoration of the involved joint in a period of eight to ten weeks with no further symptoms is the usual result in either method. Immediate surgery is suggested in cases with definite symptoms, as the condition may involve other parts of the joint, due to hemorrhages or mechanical interference.

Liebman and Iseman, on the other hand, reported a case in which a satisfactory result was obtained by immobilization alone. However, no loose body was observed in this case.

Mensor and Melody suggest arthrotomy, removal of loose fragments, no immobilization but rehabilitation therapy, diathermy, massage and graded exercises. Reporting a case of osteochondritis dissecans of the ankle joint, they state that immobilization was not applied after the loose body was removed and the surgical wound healed *per primam.*

Describing a case in the elbow joint, Murphy recommended immobilization for seven to ten days following surgery, thereby giving the joint complete rest for the first few days of healing.

Since sequestration is more complete in the ankle, elbow or knee joints, arthrotomies are relatively simple in these regions. The hip joint, however, presents operative and technical difficulties in exploration and in location of the fragments. King and Richards discuss at length the advisability of removing the sequestrated fragment. Gold reports that of the twenty-two cases of osteochondritis dissecans of the hip mentioned in the literature, conservative treatment was carried out in six, with follow-up periods varying from five months to eight years. Reconstruction and union of the fragment to the femoral head occurred in all but

one. Nine cases were presented with no report of treatment, and the remaining seven were treated surgically: arthrotomy and removal of the joint body, five cases; fusion, one case; and an arthroplasty, one case. In general, the operative results were not as successful as the conservatively treated patients. However, several patients had shown evidence of osteoarthritis preoperatively.

Fig. 1. Case I. Anteroposterior view of the left knee. Note the calcified loose body in the joint and the area of lessened density in the lateral portion of the medial condyle of the femur representing the osteochondritic bed.

Fig. 2. Case II. Anteroposterior view of the left knee. The osteochondritic focus is clearly demarcated and lying in relation to lateral portion of the medial femoral condyle which is the characteristic location of the osteochondritic bed.

According to Freund, physical therapy may temporarily relieve symptoms, but it will have no lasting effect. Surgical treatment is the only consideration for advanced and extensive epiphysionecrosis.

From the above survey then it is evident that surgery is a definite indication in patients with loose bodies in the joints. In patients in whom the osteochondritic focus is not detached from its bed, conservative therapy with a short period of immobilization and observation is suggested. Serial stereoscopic *x*-ray studies following immobilization, while the patient is on limited activity, should prove of great service in determining the progress of the lesion. If the *x*-ray visualization suggests the imminence of loose body formation, surgery is indicated. In the "slumbering type," in which the lesion is discovered merely as an incidental finding and no symptoms exist, routine observation should be pursued.

## CASE REPORTS

Case I. The patient, aged twenty-nine, entered the Station Hospital, on December 28, 1942, complaining of swelling and stiffness in the left knee. Examination revealed a moderate degree of diffuse swelling, but no tenderness was noted. The patient demonstrated a full range of painless motion with marked crepitation. On auscultation a loud, grating sound could be heard between 130 and 90 degrees.

The patient could recall no definite history of trauma to the knee, but he began to experience intermittent pain at the joint some

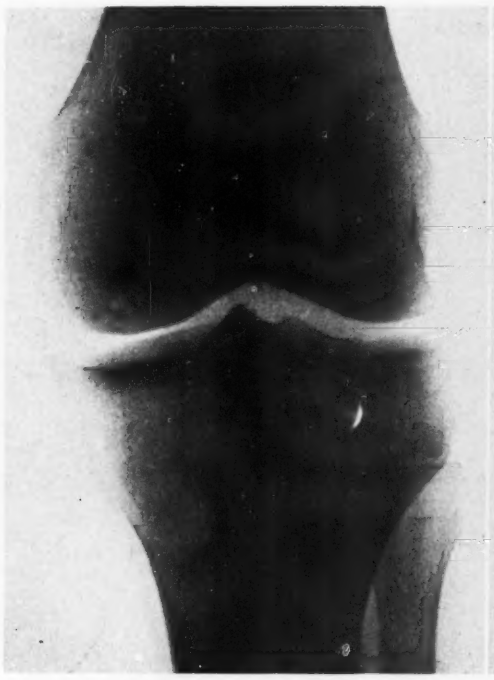

Fig. 3. Case III. Anteroposterior view of the right knee. Note the mottled lessened density in the medial femoral condyle.

Fig. 4. Case IV. Anteroposterior view of the left knee. The typical lesion and its location are easily identified.

fifteen years before. Occasional locking or buckling would occur, especially following activity in strenuous sports. However, the symptoms were never severe enough to warrant medical attention. The marching and calisthenic routine experienced in the army aggravated the symptoms sufficiently to necessitate hospitalization.

*X*-ray examination made on December 27, 1942 disclosed a mottled calcific density, approximately 2¼ cm. in diameter, lying in the anterior and lateral portion of the left knee joint, characteristic of an osteochondritic loose body. An area of lessened density was observed in the lateral portion of the medial condyle of the femur, probably the site of the osteochondritis dissecans.

An arthrotomy of the left knee was performed on January 5, 1943. A hard, white, mulberry-shaped loose body, measuring 1 by 1 5/10 cm. was discovered lying in the intercondyloid fossa. A small, depressed, stellate scar was observed on the lateral aspect of the medial condyle. Several shallow grooves on the articular surfaces of the condyles were also noted, apparently the result of trauma caused by the loose body. The loose body was excised, but no attempt was made to resect the area of osteochondritis, as it appeared healed.

The patient made an uneventful recovery and was able to return to duty on January 29, 1943. A recent interview disclosed the fact that he is now able to continue his marching and calisthenic routine without pain, locking or buckling of the knee. Swelling has never recurred.

Case II. The patient, aged forty-two, entered the Station Hospital on January 10, 1942, with a complaint of frequent locking of the left knee. Examination revealed a full range of motion, no tenderness or swelling, but considerable crepitation. On repeated examination, a pea-sized loose body could be palpated at the joint line, at times on the lateral side, and at other times on the medial side of the joint.

The patient presented a history of "rheumatism" in the knee for the past twenty years, characterized by stiffness and occasional mild swelling. On February 7, 1942, he stepped on a corn cob and snapped the left knee into hyperextension, causing severe pain, limitation of motion and swelling. These symptoms gradu-

ally subsided over a period of three months. In May, 1942, the knee began to lock and the loose body was first felt on the lateral aspect of the joint. Locking became more frequent thereafter, often occurring several times a day. The knee would frequently give way suddenly, causing him to fall several times while marching.

An *x*-ray taken on January 7, 1943 visualized a spherical calcification, approximately 1¼ cm. in diameter, lying in relation to the lateral portion of the articular surface of the medial femoral condyle, representing an osteochondritis dissecans. Arthritic changes were noted, involving the tibial spines and the articular surfaces of the proximal end of the tibia. A second calcification of similar size was seen lying in relation to the medial condyle of the femur on a plane approximately 2 cm. above the knee joint interspace.

An arthrotomy of the left knee was performed on January 30, 1943. The exposed joint revealed a moderate degree of osteoarthritic change, evidenced by lipping at the edges of the joint surfaces. A deep crater, measuring 1 by 1⅝₁₀ cm. in diameter, was observed on the inferior surface of the internal condyle, near the attachment of the posterior cruciate ligament. A loose body, lodged within the crater, was lifted out with a forceps, disclosing a rough, purplish lining in the crevice. This surface was freshened by superficial curettage. Further exploration of the joint revealed another loose body lying in the suprapatellar pouch. This button of bone was smooth, hard and white, 1 cm. in diameter.

The postoperative course was uneventful. The patient was discharged from the hospital on March 12, 1943. In a recent interview, he said that neither locking nor buckling had recurred since the operation, but the joint was still moderately painful and weak on weight bearing. A slight limp persisted.

Case III. This patient, aged nineteen, was admitted to the Station Hospital on November 24, 1942, with a complaint of pain in the left knee. Neither swelling nor limitation of motion were observed on examination. The joint was stable, but a small area of tenderness over the anterior attachment of the internal semilunar cartilage was noted. The patient walked with a slight limp.

Nine days of bed rest relieved the symptoms, so the patient was returned to duty. However, the marching and calisthenic routine caused a recurrence of a full, aching pain. He was readmitted to the hospital on January 28, 1943.

The onset of the symptoms followed an injury on July 23, 1942, when he struck his knee against the steel shaft of an armature while working at a power plant. The knee became swollen and stiff and the pain incurred persisted. A series of heat treatments were given but no relief occurred. Following enlistment in the army on October 30, 1942, the symptoms were aggravated by the ordinary routine of basic training.

Fig. 5. Case v. Anteroposterior view taken preoperatively. Note the button of bone lying in the femoral bed.

An area of mottled density in the lateral portion of the medial condyle of the femur, near its articular surface, was revealed by the roentgenogram taken January 12, 1943. A diagnosis of ostochondritis dissecans was made.

An arthrotomy of the left knee was performed on February 3, 1943. When the joint was exposed, a small amount of clear, straw-colored fluid was encountered. An area measuring 2 by 2½ cm., the surface of which was paler than normal and slightly raised above the surrounding surface, was seen on the lateral aspect of the internal condyle near the attachment of the posterior cruciate ligament. This area was outlined with the point of a scalpel, the incision

being carried through the cartilage. The incised cartilage was not attached to bone and was easily lifted out with a forceps, thereby exposing a crater in the bone with a grayish-purple surface which was freshened with a curette. No other changes were noted in the joint.

The postoperative course was uneventful, except for a rather marked effusion during the first two weeks. The patient was discharged from the hospital on March 25, 1943, with no complaints.

Case IV. The patient, aged twenty-three, was admitted to the Station Hospital on January 25, 1943, complaining of pain and stiffness in the left knee. Examination revealed a knee which appeared normal, with no swelling or tenderness and a full range of painless motion. However, a slight limp accompanied walking.

The patient could recall no history of trauma. The onset of symptoms occurred in December, 1940, at which time he began to limp, because of severe pain on weight bearing. After several weeks of this, the symptoms cleared up spontaneously, except for mild pain while walking.

Following induction into the army in November, 1942, the basic training routine increased the pain sufficiently to cause a limp and occasional stiffness in the knee joint. However, neither locking nor buckling ever took place.

*X*-ray examination on January 5, 1943, revealed an oval area of mottled density in the lateral articular portion of the medial condyle of the femur, characteristic of an osteochondritis dissecans. No loose bodies were noted in the joint at this time.

An arthrotomy of the left knee was performed on January 28, 1943. Inspection of the joint showed that the joint cartilage was pale and dimpled over an area of ½ cm. in diameter on the lateral aspect of the internal condyle near the attachment of the posterior cruciate ligament. A scalpel was used to outline the area, the incision carried through the cartilage. The cartilage and a small piece of attached bone were then easily lifted out, leaving a crater 1 cm. in diameter. The base of the crater presented a purple, velvety surface, which was freshened with a curette.

The postoperative course was uneventful and the patient was discharged from the hospital on March 12, 1943. A recent interview disclosed the fact that he is now on full duty, but excused from calisthenics temporarily. No limp was observed but there was a slight limitation of flexion.

Case V. This patient, aged twenty, was admitted to the Station Hospital on January 22, 1943, with an acute appendicitis. An appendectomy was performed on the day of admission with an uneventful postoperative course.

During the patient's stay in the hospital, he was seen in consultation by the orthopedic surgeon, regarding a painful left knee. Physical examination revealed no swelling or tenderness. The knee was stable and there was a full range of painless motion. However, the patient walked with a slight limp.

Past history revealed no indication of trauma, but the onset began in 1938. The pain was present on weight bearing and most severe while walking. The knee occasionally gave way, causing him to fall. Locking never occurred, but a sudden stop in an elevator would cause pain and buckling. Symptoms were grossly aggravated by the army routine.

An oval button of sclerotic bone was visualized in the lateral articular portion of the medial femoral condyle in the *x*-ray examination made on February 5, 1943. This finding was pathognomonic of an osteochondritis dissecans. No loose bodies were noted in the joint at this time.

An arthrotomy of the left knee was performed on February 17, 1943. A pale, dimpled area, 1½ cm. in diameter was outlined with a scalpel on the lateral aspect of the internal condyle of the femur and easily removed. The remaining crater was freshened with a curette.

The postoperative course was uneventful and improvement was rapid. The patient was returned to duty with an excuse from calisthenics on March 18, 1943. A recent interview revealed that buckling had not recurred since the operation, but there was still some pain, especially on weight bearing, causing a slight limp.

## SUMMARY AND COMMENT

1. A résume of the literature pertinent to osteochondritis dissecans was presented.

2. The importance of early diagnosis and early treatment was stressed to avoid subsequent involvement of disabling synovitis or arthritis.

3. The value of *x*-ray examinations, including stereoscopic and serial studies, was discussed.

4. Five cases were reported with *x*-ray illustrations and operative findings included.

5. Careful observation of these cases will be continued to determine their fitness for full duty or limited service status.

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# PILONIDAL CYST

## THE POSTOPERATIVE PROBLEM

LESTER A. BARNETT, M.D.
Assistant Junior Attending Surgeon, Middlesex General Hospital and on Staff, St. Peter's General Hospital, New Brunswick, New Jersey
MILLTOWN, NEW JERSEY

PILONIDAL cyst has become a current surgical problem principally because of World War II and the resultant massing together of thousands of people who fall into the proper etiological group as to age, sex and race, and are subjected to the exacerbating conditions of trauma and strenuous physical activity. The literature is being enriched with many articles dealing with this problem, principally with the matter of operative treatment as a military problem primarily. The search is being made for the method which will hospitalize a soldier for the least amount of time and yet give him a healed wound able to protect the sacrococcygeal region against the unusually severe types of trauma met with, such as riding in jeeps, trucks and tanks, running obstacle courses and going through battle without becoming a "postoperative casualty."

The old controversy of excision and open packing versus primary closure has been renewed.[1–8] The method of primary closure has been given great impetus by the demands of military treatment for it is certainly the method of choice under such conditions. When successfully employed it enables the military surgeon to get the soldier back to active duty in less time and with greater protection against trauma to the sacrococcygeal area than either the open method or any other method yet devised.

Much has been said about the etiology, pathology and treatment of pilonidal cysts but not enough stress has been laid on the importance of postoperative care, regardless of the method of treatment employed, as related to proper healing and recurrences. This paper deals with this latter problem, especially as it applies to open wounds, whether they are a result of (1) excision and open packing, (2) partial closure, (3) a primary closure which has had to be reopened, (4) recurrences, (5) injuries to the healed scar, or (6) failure of any of these types of open wounds to heal. For certainly, the kind of postoperative care given will determine not only the healing time but, as important, the type of scar resulting and consequently the likelihood of recurrences.

The goal of primary closure methods is to eliminate the problems attendant upon open wound care and concentrate on those problems peculiar to closed wound healing such as complete removal of diseased tissue, absolute hemostasis, obliteration of dead space, accurate approximation of wound edges without undue tension, postoperative "wound sanitation" and protection from traumatizing factors until healing is complete. New procedures are being devised and tested on large groups of patients, particularly in the military hospitals,[8–12] to master these problems, and new agents are now available to combat the infection usually present in pilonidal cysts and, until now, the chief contraindication to primary closure. The sulfonamides, used both locally and systemically, have made the problem a much easier one, and if penicillin can be made available for such use it may markedly affect the percentage of cures by primary closure. However, the problem of open wound care will yet be the greater one for many reasons. Many pilonidal cysts with ramifying tracts and multiple sinus openings are too extensive

for primary closure. A few are found to run deeply, infecting the underlying sacrococcygeal ligaments and even the vertebrae of the sacrum and coccyx; removal, or even curetting, of these parts will not permit primary closure. Also, many adherents of the open method still consider it the method of choice in military service,[1] and in civilian practice, where the factors are certainly more compatible with this method, the members of this school are understandingly in the majority.[7,13] Finally, many cases fall into the open wound category as failures of primary closure either as a result of poor surgical technic and/or overwhelming infection or as recurrences.

The process of recurrence is really one of "pseudo-recurrence" for it is generally agreed that a true regrowth of the original disorder is now rarely encountered. [12,14–17] All operators recognize the importance of completely excising every vestige of diseased tissue either by direct visualization and careful dissection or by block excision with or without identification by dye (methylene blue) injection. We believe it is also important to remove the diseased tissue with the least amount of contamination, by sealing the sinus opening (or openings) and taking particular care not to rupture the cyst during excision even when primary closure is not contemplated. The all too common recurrence is in reality a result of one or a combination of many possible artifacts: dead space resulting from improper use of a drain or from poor placement of deep sutures, chronic infection introduced during operation from the cyst and/or operative technic or during the postoperative course, improper hemostasis, poor packing in open cases, the unhygienic location of the wound, and postoperative negligence on the part of the surgeon or the patient.

### PRIMARY CLOSURE METHOD

Postoperative care for primarily closed wounds is generally routine but modified according to the type of closure attempted. The most common procedure entails excision of the diseased tissue either in an elliptical block or by careful dissection of the involved areas only. After complete hemostasis with fine sutures a sulfonamide powder—sulfanilamide, plain or buffered[18]—is evenly spread throughout the wound, taking particular care that large collections of powder are not left to act as foreign bodies. Penicillin solution is believed to be even more efficacious; it is squirted into all corners of the wound and may even be injected into the walls of the cavity for short distances in every direction with an ordinary 10 cc. glass syringe and needle. Undermining of the wound edges is frequently undertaken to provide approximation without undue tension. The sutures are then placed in various ways according to the preference of the operator. Usually a deep row approximates the deep edges of the flaps to the fascial floor to eliminate dead space thoroughly; a drain may be inserted at this point, if desired, before tying the sutures. The skin edges are approximated with a few vertical mattress sutures without undue tension. Some authors[3] believe that retention sutures of silkworm gut, silver wire or alloy steel wire tied across the wound or over rolls of gauze are valuable for additional pressure and support. Certainly pressure in some form is necessary to help eliminate dead space and aid hemostasis; sterile mechanic's waste or fluffed gauze dressings are excellent for this purpose. Most operators use tight adhesive strapping for immobility and protection.

From the operating table the patient is immediately rolled over onto his back and is kept in this position for twenty-four hours. During the next three days he is allowed on his abdomen but it is believed he should not lie on his side until the fifth day as this indirect force may shear one edge of the wound from the other. The usual postoperative sedation is given according to the needs of the individual patient and the preferences of the attending surgeon. If a sulfonamide has been

given orally for two to three days prior to operation (we prefer sulfadiazine, 4 Gm. daily), it is continued for the same length of time postoperatively or longer when indicated. We find this valuable, in conjunction with the sulfanilamide powder (or penicillin solution) used locally, for those cases presenting grossly infected cysts. A liquid diet is given for two days, a soft diet the third and fourth days, followed by a regular diet thereafter. Six 4 cc. doses of paregoric are given at four-hour intervals to discourage bowel movements. On the morning of the seventh day a lubricating type enema is given and at the same time cascara sagrada, 4 cc., in mineral oil, 30 cc. is given orally. The patient is first allowed out of bed for bathroom privileges on the tenth day provided there is no contraindicating wound disturbance.

The dressing is changed the first day to remove the drain if one has been used, otherwise in the absence of evidence of wound infection it is not inspected until the fifth day. At that time the removal of sutures is left up to the judgment of the surgeon as regards the healing of the wound. Usually all the skin sutures are removed if retention stays are present. Every other suture is removed if there is any doubt of complete healing. If there is evidence of infection around the suture or necrosis of skin edges, the guilty sutures are removed. The original type sterile pressure dressing used in the operating room is then reapplied. Inspection of the wound every two or three days is essential if complications to good healing are to be combatted at their inception. If evidence of infection deep in the wound presents itself, the wound is opened without delay. Frequently only a portion of the wound need be opened and thus a partial closure remains.

The extent of the area to be reopened is best determined by gentle probing into the depths of the wound and up and down the healing tract. A minimum of healing should be broken down, particularly near the deep layer of sutures, but at the same time good healing by granulation will not proceed until all pockets, tracts and overhang are broken down to form a smooth-walled cavity with adequate drainage facilities.

Occasionally, a borderline case presents itself which to the average observer is not suitable for primary closure. We believe that a primary closure may be attempted with the reservation that it can always be reopened if primary healing does not take place because (1) no time is lost, (2) frequently the approximation for even a few days helps by decreasing the space to be filled in by granulation, (3) the resulting scar is usually stronger and (4) if primary healing does occur it is more than "worth the chance." Weeks and Young[12] have observed that healing occurs faster in a reopened primary closure than in one left open originally.

The final problem with closed cases is the return to active duty. This problem, not met with in civilian practice, is the "acid test" of primary closure. There have been surprisingly few recurrences among the patients returned to duty two to four weeks after operation.[3,8,9,11,12,18] The patient is left with a more normal pad over his sacrococcygeal region and a narrow, strong scar, a much more desirable situation for the rigors of military life than the thin, wide scar of the open method. However, in civilian practice it is advisable to keep the patient from all activity involving the operative site for one month, allowing return to full physical activity (horseback riding, truck driving, etc.) in three months from the time of operation.

### OPEN PACKING METHOD

When block excision with open packing is the procedure chosen, the immediate postoperative care is simplified but late care is occasionally complicated. A large defect usually remains, packed with iodoform or vaseline gauze. Wide adhesive strapping is used to decrease the tension

and the size of the cavity to be filled in. The patient is kept on his back for the first twenty-four hours for the same purposes as stated above. However, he is allowed out of bed on the second day and no attempt is made to control the bowels; a regular diet is given at that time and catharsis when indicated. Sedation is given when necessary but there is little postoperative discomfort from either of the operative procedures mentioned.

For the first few days there is a large amount of gelatinous discharge containing tissue and blood débris, necessitating daily dressings. When the "necrotic cast" of the cavity has been shed, healthy granulation tissue is already found to be filling in the defect. The rate of granulation depends upon many factors which influence healing in all the types of open wounds to be discussed.

*The healing ability of the patient* is not a factor that can be quantitatively measured but is an individual characteristic that can be clinically observed. Frequently we see, under the same conditions of environment and diet, one patient heal in half to three-fourths the time required for the average case. At the other extreme I have observed a patient, a white male aged twenty-three years, who had been hospitalized for fifteen months and subjected to several surgical procedures without complete healing ever having resulted. Exhaustive studies had not determined the causative factor. Certainly, special diets high in vitamin intake, stressing vitamin C, should be part of the postoperative regimen in all cases of delayed healing. Light exercise, a convalescent environment and freedom from worry are factors to be striven for, when feasible, to enhance those natural qualities possessed by the patient.

*Neutralizing the infection* always present is directed principally at those organisms usually cultured during healing: staphylococcus, streptococcus, pneumococcus and pyocyaneus. Until penicillin can be made generally available for this use it is believed that the sulfonamides, locally and orally, offer the best means of combatting the initial bacterial "mass invasion." However, they should not be used locally more than a few days for we have observed, as has Tendler,[14] that an unhealthy looking gray granulation tissue forms which heals slowly. There are many agents to choose from for initial wound antisepsis with, or in place of the sulfanilamide powder suggested: iodoform gauze packing, azochloramid in triacetin (1:500) impregnated gauze, mercurochrome, chlorazene, Meleney's zinc peroxide, BIPP gauze, etc. When dressings are changed, irrigating with Dakin's solution, azochloramid solution, peroxide, saline, boric acid solution or distilled water removes most of the necrotic material. I have not used the whirlpool bath here but in view of my experiences with it for cleansing sloughing third degree burn wounds[29] I deem it worthy of trial. After one week the discharge is usually light and it is believed that infection has also diminished. A thought is now given to stimulation of healing properties and such agents as Brezin's sulfathiazole, cod liver oil, lanolin ointment,[9] 5 per cent sulfadiazine in vaseline or aquaphor, or any of the sulfonamide-urea products are used until the infection problem is superceded by that of wound healing alone.

*Wound control* requires a constant "devotion" to the problem of policing a progressive yet indeterminate process. At this point the surgeon's skill may influence the final result in as much a degree as his skill in the operating room. The cavity has now decreased in size and depth presenting healthy granulation tissue on all sides and along the base. The list of agents available to promote healing is familiar to every surgeon: cod liver oil, balsam of Peru, scarlet red, Lassar's paste, etc. The important point to be made is that regardless of the agent selected it must be used to its greatest efficiency for a satisfactory result. It is a common observation that different cases respond in different degrees to the same

agent so that after a fair trial and failure it should be replaced by another. Then, too, an efficacious agent may help up to a certain point and then be useless or even obstructive to further healing. After the unsuccessful use of complicated and often expensive compounds the attendant is often amazed to see a change to plain vaseline or boric acid ointment speed the healing on its way. Hot Sitz baths, two to three times daily, have long been a favorite of postoperative care, starting within a day or two after surgery[7,14] or later when other methods fail, and is now being used routinely for primary closures by Weeks and Young.[12] It is not without certain disadvantages. Because the patient is responsible for his own care, the efficiency of this method is proportional to the patient's intellect and diligence. The surgeon must be prepared to inspect the healing process regularly or pocketing and undermining will occur and the resultant scar will cover a multitude of defects. He must be familiar with the use of other agents and not hesitate to change over should healing become stationary.

Excessive or irregular healing is frequently a problem in wound control. Kleckner[7] believes the altered blood supply is responsible for peculiar types of healing. Where granulations rise above the level desired for proper epithelization, they are burned down with the caustic stick or leveled with scissors; where the rate of growth is but slightly excessive, a dressing of nickel pectinate serves to slow down granulation. Tendency to undermining or pocketing must be broken up constantly so that healing is solid, or recurrences will result.

If at any time evidence of infection overwhelms the healing process, a short recourse to any of the initial "wound cleansers" will prove adequate.

*Wound sanitation* requires a change of dressing every two to three days and whenever the dressing becomes soiled from a bowel movement. Because of the location of the dressing in the intergluteal fold one is sure to find débris consisting of hair, clothing lint and epithelial scales in the wound. All such material is thoroughly cleansed from the wound at every dressing. The pilonidal cyst is more commonly found in patients with an excess of body hair[19,20,21] so that it can be expected to grow around the edges of the wound in seven to ten days postoperatively. These hairs are carefully shaved away whenever they appear, for they prevent epithelization where they exist and thus plant the seeds of recurrence. We have not found it necessary to use exfoliating doses of *x*-ray for this purpose but for a recent case of hyperhidrosis of this region *x*-ray was attended with good results. Surrounding infection from adhesive strapping is best controlled by applying tincture of benzoin to the skin before strapping. Succeeding layers are placed over the first adhesive in as many layers as permissible. Where skin excoriation is marked, a tight muslin binder is substituted and the excoriated area covered with strips of sulfadiazine impregnated gauze. Dressings are large enough to cover the wound completely, thick enough to absorb all anticipated drainage and secured firmly enough to prevent slipping and contamination of the wound.

*Trauma prevention* is obtained through proper dressing of the wound and explicit directions to the patient as to the type and amount of activity he may engage in. For one month following healing the scar is protected with a small strip of absorbent cotton held in position by the patient's underwear; during this period activity is gradually increased. The military patient is then returned to active duty. The civilian patient is advised to wait an additional month or two before undertaking full physical activity.

### PARTIAL CLOSURE METHOD

Several authors[16,20,22,23,24] advocate a partial closure of the defect, with or without drainage, for all cases adaptable. We

consider this method applicable only to the cases in which primary closure cannot be attempted even by "taking a chance" of partial reopening, and yet considerable healing time could be saved by closing either or both ends of the wound. The case with a large infected cyst and long, winding, narrow sinus tracts is best attacked by this procedure, closing the tract defects primarily and allowing the large cyst defect to granulate in slowly.

Whether a partially closed wound results from operation or from the reopening of part of a primarily closed wound, the postoperative care is essentially that of the open wound already described. Certain features require special attention. Because a closed wound exists adjacent to the open area the sutured region is protected from contamination as much as possible; hot Sitz baths serve admirably here for both types of wound present. Tunneling from the open area into the recesses of the closed section is the rule unless constant wound control is maintained. The open cavity is usually quite narrow in partially closed cases so that "bridging" is a characteristic complication; it is a result of epithelization across the narrow gap prior to complete granulation of the wound. The result is a thin, false scar that conceals infectious débris. This is a frequent cause of recurrence, for so quickly does this "skin" form that the attendant will find the wound completely "healed" since the last inspection two days previously and discharge the patient as cured. It requires but light physical activity to split the membrane but this may not occur for a week or two, during which time the infectious process beneath has ample time to form a deep, undermined crater with tunneling sinuses. This is best prevented by recognizing the membrane, often by its blue-gray color, and removing it. It is wise to suspect any tissue formed too quickly, whether epithelization or granulation. If a flexible probe—a whale-bone probe is excellent—is held in the hand during each dressing, the tendency to use it will reward the surgeon with surprising discoveries.

As with the primary closure method, a word of caution to open the adjacent closed portion immediately should evidence of infection appear in this region; open well beyond the involved area and tend to "saucerize" to prevent recurrent undermining of the edges, saving as much sutured portion as is safe.

### MISCELLANEOUS METHODS

Cutler and Zollinger[25] have had success with a modified Carnoy's solution for sclerosing pilonidal cysts and sinuses. In the hands of Rogers and his associates[17,26,27] the fractional cautery excision has yielded excellent results. Both procedures result in an open wound which is treated much the same way as mentioned, the sclerosed lining in the former method first being curetted out.

### TRAUMATIZED SCARS

Occasionally, following discharge the patient returns with a sharp crack or split in the scar or a more superficial irritation. This usually occurs during the first month following healing and a history of a bumpy truck ride, 500-mile train trip or the like is supplied. This type of injury is not serious and is more commonly seen in the wide thin scars of the open packing method. Treatment consists of a thorough cleansing, including shaving of all adjacent hairs, and application of any bland ointment—10 per cent boric acid ointment. A small piece of absorbent cotton stuck to the ointment will suffice as a dressing. Healing is complete within a week.

### RECURRENCES

The factors responsible for recurrences have already been discussed. Where a small area is involved, it need only be opened beyond the undermined edges and the walls and floor débrided with a small scalpel blade or curette; it is then treated as an open wound. The entire procedure may be done without anesthesia. If the

greater part of the wound is involved, it is best to reoperate and excise the entire area, and attempt the closure deemed most likely to give a complete cure. This decision frequently depends on the cause of the recurrence, for when due to an unusual injury and not a result of poor healing a primary closure can be considered. However, the greater percentage of recurring cases, originally closed or left open, will finally come to either a partial closure or open packing regardless of the time that will be lost, for the requirements of healing are easier to meet.

### REFRACTORY CASES

Every series of surgically treated pilonidal cysts contains a few refractory cases upon which repeated procedures have effected no permanent cure. A complete study of the patient as a whole is the first step to be taken, bearing in mind those entities linked with poor wound healing: tuberculosis, syphilis, malignancy, vitamin c deficiency, etc., and then a search for local causes: fungus infection, anaerobic infection, osteomyelitis of the sacrococcygeal vertebrae, rectal disorders,[28] communication with spinal contents (rare), etc. In all cases, preoperatively, we advocate routine *x*-rays, anteroposterior and lateral, of the sacrococcygeal spine and careful rectal examination. In refractory cases these are repeated and a chest plate ordered. The injection of lipiodal may expose deep pathological conditions. We do not use it preoperatively as a routine procedure but only when indicated. Blood chemistry, including a vitamin c blood level, is often instructive. Repeated culture of the wound frequently reveals the responsible organism. A biopsy of the broken down tissues is essential, and when reoperation is performed the excised tissues are subjected to microscopic study and culture.

Certain local agents prove effective in many cases when expertly employed. Where anaerobic organisms are cultured, Meleney's zinc peroxide therapy, coupled with peroxide irrigations, is valuable. For fungus infection the ordinary salicylic acid-sulfur preparations will suffice. Quartz lamp therapy is occasionally able to arouse healing properties and the use of *x*-ray for local hyperhidrosis has been mentioned. We have had an opportunity to try many new agents advocated for refractory wound healing but none deserves special recognition as yet. Skin grafting is recognized as a good procedure[12] but it should be used more often and earlier than is the custom.

The healing ability of the patient must again be mentioned as a vital factor which when stimulated can produce unexpected results. We have all seen the refractory case sent on furlough, or vacation, for a month, return with his general health built up and the wound soundly healed.

In the military service there is still another factor to be thought of when confronted with a wound which to all intent should heal but remains dormant. The soldier who does not wish to return to duty will, in rare instances, prevent healing of the wound by engaging in prohibited strenuous exercise in order to break down healing tissues, or irritate and contaminate the wound by some simple method. Where suspected the evidence can usually be detected. The treatment must then be supplemented with enforced bed rest and well padded dressings secured firmly with adhesive strapping.

### SUMMARY

1. Military requisites demand a method of treating pilonidal cysts that requires little postoperative care and furnishes a well healed protective scar. Recently developed technics of excision and primary closure of selected cases in conjunction with sulfonamide therapy offer the best solution of this problem.

2. The more conservative method of excision and open packing is indicated in many cases not amenable to radical surgery. In civilian practice it is the surgical procedure of choice.

3. Recurrences are common following all types of surgical treatment for pilonidal

cysts. Diligent postoperative care is the chief prophylactic measure.

4. The postoperative problems peculiar to each method of surgical management are discussed and a plan of care outlined for each.

5. The refractory case presents a difficult healing problem which must be carefully investigated for the causative factor. Several remedies are mentioned.

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# CARCINOMA OF THE RECTUM

## CONSERVATIVE SURGERY IN CERTAIN INSTANCES

COMMANDER DONALD R. KELLER
MEDICAL CORPS, UNITED STATES NAVAL RESERVE

THE treatment of malignant and of potentially malignant diseases today is based on principles that have reached a high degree of standardization. At the present time more attention is given to the potentially malignant disease in an effort to eradicate this condition before deep-seated infiltration and secondary metastasis have occurred. This is most applicable to early lesions of the rectum and lower colon.

Polypoid disease of the rectum and colon fall under two definite but not clearly differentiated types, mainly multiple and solitary. The latter type is more commonly found located in the rectum and lower sigmoid. Staemmler, from a series of eighty cases, reported 58 per cent in the rectum and 13.2 per cent in the sigmoid.

Malignant change in the base of polypoid growths of children is not infrequent. Bacon found eight cases of patients under the age of twenty years out of a series of 1,995. One patient, four years and seven months of age, showed early malignant change in a polyp removed from the rectum.

Phifer, in a series of forty-nine cases, found twenty-two patients with malignancy under fifteen years of age; twenty-seven patients were between the ages of fifteen and twenty years.

Schmeiden and Westhue's classification of polyps described three histological forms: The first benign type is usually a solitary lesion made up of an abundant tissue stroma, covered by a normal mucous membrane layer of epithelium identical with sigmoid or rectal lining. A second group is composed of a similar stroma covered with a more atypical cellular mucosa showing some undifferentiated areas. The third precancerous type exhibits an irregularly arranged epithelial covering and shows a definite lack of differentiation of the epithelial cells. The portion of the tumor undergoing malignant change is the base and may be suspected clinically by its raised and indurated appearance. To this classification a fourth group can be added, namely, that type of solitary polyp which shows definite malignant changes at the base and not showing any evidence in the stalk. Early diagnosis of this latter type before invasion of the submucosal layer is extremely important. As already stated above the greatest percentage of polyps is located in the rectum and the sigmoid, and they are associated with precancerous and actual cancerous changes.

The author believes that more emphasis should be put on the routine examination of patients especially in reference to the study of the rectum and colon. This can be carried out readily by routine proctoscopy and sigmoidoscopy at six-month intervals. Barium enema with fluoroscopy and *x*-ray may be added for study of the higher colon if desired. In carrying out this procedure once a polyp is found in the early stage of change. It can be treated conservatively and with little loss of time and expense to the patient.

The surgeon, having found the solitary polyp in the rectum or sigmoid, should immediately ascertain the degree of the disorder. This is best obtained by taking two or three biopsy sections from separate areas of the tumor base. Strictly benign lesions and those classified by Schmeiden and Westhue as showing precancerous changes can be treated according to their location: Lesions of the sigmoid and rectal sigmoid are best treated by the abdominal

route; lesions of the upper rectum and especially those of the anterior wall are satisfactorily treated by the Bevan operation; for those lesions involving the lower five inches of the rectum, but only those located on the posterior and posterolateral walls, the technic described by the author is best suited. However, for those cases showing malignant changes which extend from the base through the submucous layer of the rectum, the radical combined abdominal-perineal resection, either as a one- or two-stage procedure is recommended. In certain of these cases, the surgeon may encounter a patient who does not present a satisfactory risk for the radical abdominal-perineal procedure. The author wishes to report a case of a seventy-year old male, who clinically did not present a good risk and was treated with the operative technic described below:

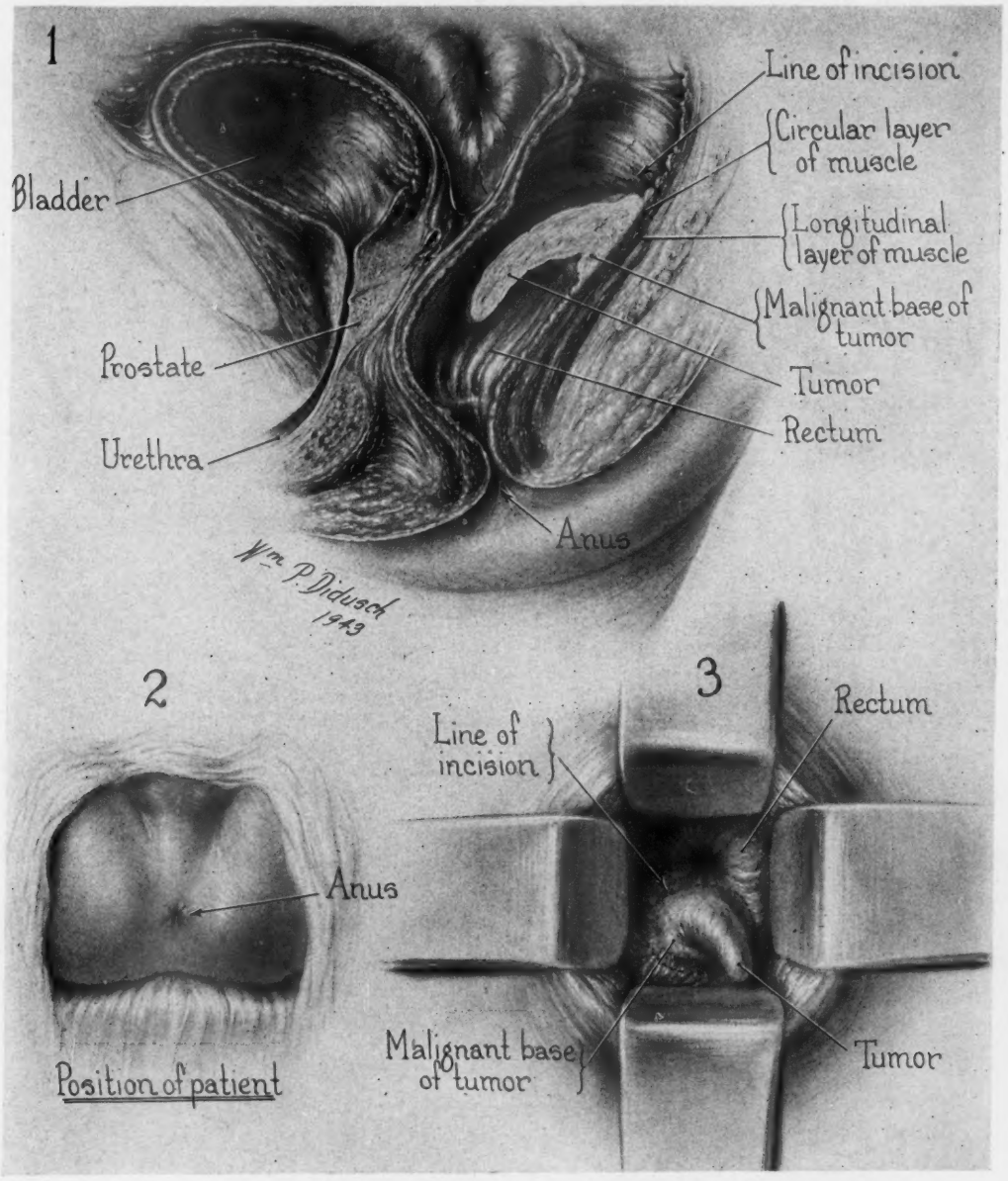


Fig. 1.

## CASE REPORT

The patient, Mr. L. D. S., first came to the clinic June, 1939, for a usual yearly check-up. Examination revealed a small thrombosed

external hemorrhoid. Digital examination disclosed a large movable mass 8 cm. up on the posterior wall of the rectum. Proctoscopic examination showed a normal rectal sigmoid junction and an entirely normal rectum, except for the presence of a polypoid mass in the posterior wall. It measured exactly 3.5 cm. in length. The base of the tumor was elevated and indurated and appeared somewhat congested. Two biopsy specimens taken from separate parts of the indurated base revealed the following pathological changes:

Microscopic section showed a moderate number of polyp-like pieces of tissue, covered by atypical tubular glands. Many of the glands showed secondary budding lined by papillated epithelium. The lining epithelial cells were large, columnar in type and had moderately large hyperchromatic nuclei. The connective tissue core of the largest polyp showed slight infiltration of atypical epithelial glands. There was also fibroblastic proliferation and lymphocytic infiltration. Another section showed gigantic atypical tubular glands lined by papillated columnar cell epithelium. A moderate number of mitotic figures were seen throughout. Diagnosis: Rectal tissue: Adenocarcinoma (adenoma destruens); chronic, cellular and productive infiltration.

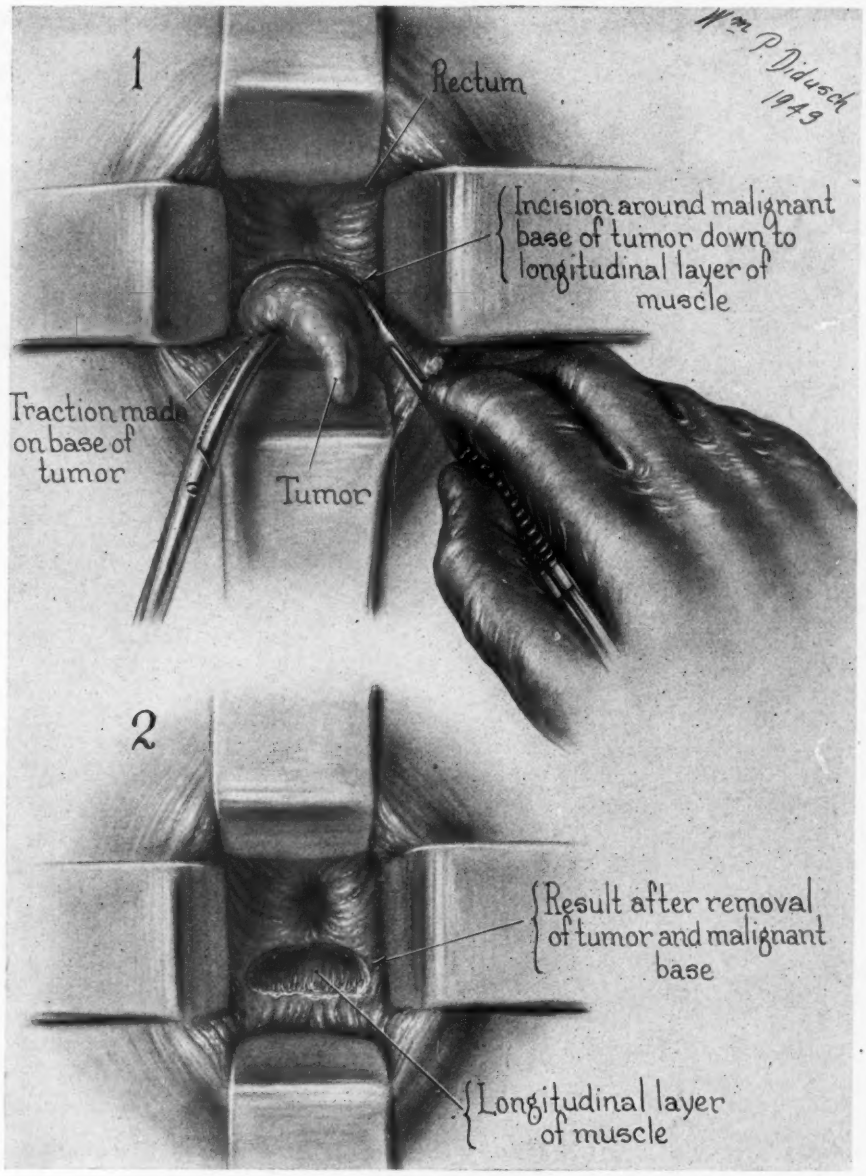
1
Rectum
Wm. P. Didusch 1949
Incision around malignant base of tumor down to longitudinal layer of muscle
Traction made on base of tumor
Tumor
2
Result after removal of tumor and malignant base
Longitudinal layer of muscle

Fig. 2.

Physical examination revealed the head and respiratory systems to be normal.

Pulse: The pulse was regular with good

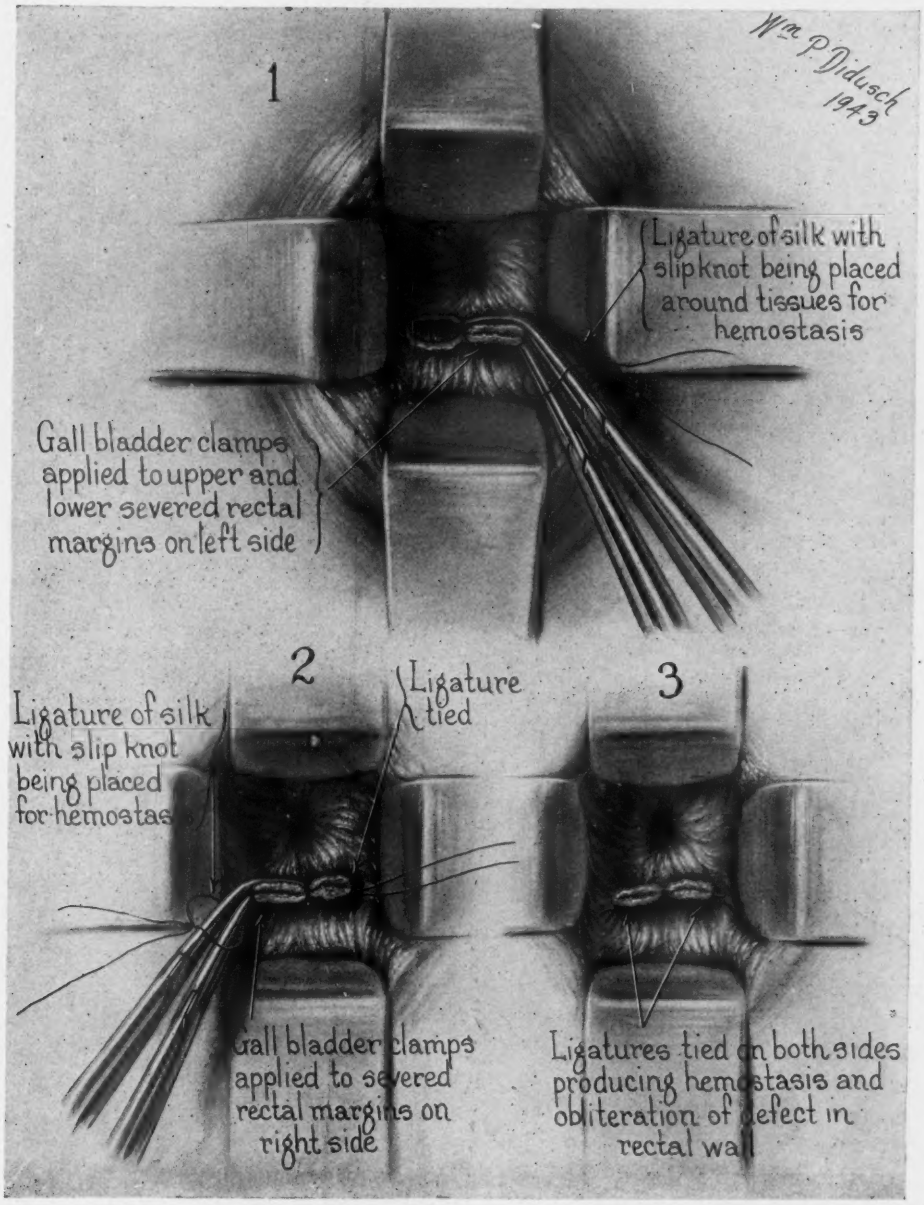
Wm P. Didusch 1943
1
Ligature of silk with slip knot being placed around tissues for hemostasis
Gall bladder clamps applied to upper and lower severed rectal margins on left side
2
Ligature of silk with slip knot being placed for hemostas
Ligature tied
3
Gall bladder clamps applied to severed rectal margins on right side
Ligatures tied on both sides producing hemostasis and obliteration of defect in rectal wall

Fig. 3.

volume. The blood pressure was 140/60. There was slight enlargement of the heart on percussion and flouroscopy. There were no organic murmurs. The abdomen was retracted. There were no visible or palpable masses or palpable inguinal nodes. The external genitalia were normal. The prostate gland felt irregular in shape, considerably enlarged, and had moderately firm consistency. Urinalysis was essentially negative.

The blood picture revealed the following: hemoglobin, 60 per cent; erythrocyte count, 3,100,000; leucocyte count, 8,000; there were 64 per cent polymorphonuclears, 18 per cent small lymphocytes, and 8 per cent large lymphocytes; eosinophils were negative.

Morphine sulfate, ½ gr. hypodermically, was given one hour before the operation. The patient was placed in the lithotomy position and 50 mg. of metycaine were given intraspinally.

Twenty minutes after the administration of the spinal anesthesia, the anal sphincters were gradually dilated by digital means. Malleable retractors were then inserted at the upper and lateral angles of the dilated anal orifice. A

heavier similar retractor was then inserted along the posterior and anal-rectal wall up to the base of the mass which bulged forward into a clearer view. (Figs. 1, 2 and 3.) Following this, a long eight-inch clamp was loosely inserted into the base and with mild traction a transverse elliptical incision was carried out above and below the base of the polyp, so as to meet on each lateral side. These incisions were carried down to the longitudinal muscular coat. The polyp and base were removed intact.

Considerable bleeding was encountered and immediately controlled by applying a narrow gallbladder clamp to the upper and lower severed rectal margins on each side. The space did not permit suturing, so a slip knot tie of silk was inserted over the handles of each clamp on one side and when properly placed beneath the clamp ends, was firmly drawn together and the clamps slowly removed. Similar ligation was carried out on the opposite side. This afforded excellent hemostasis. Following this, a dry gauze pack was carefully inserted well above the operation site and one end allowed to protrude from the anus.

The patient was kept in bed for four days, during which the routine, postoperative hemorrhoidal diet was carried out.

Eight days following operation, a large one and one-eighth inch bore proctoscope was inserted and the raw puckered margins of rectal mucosa were carefully cauterized down to a level of the adjacent mucosa. Very little bleeding was encountered. The patient was proctoscoped six weeks later and a very satisfactory linear scar was present with no evidence of stricture.

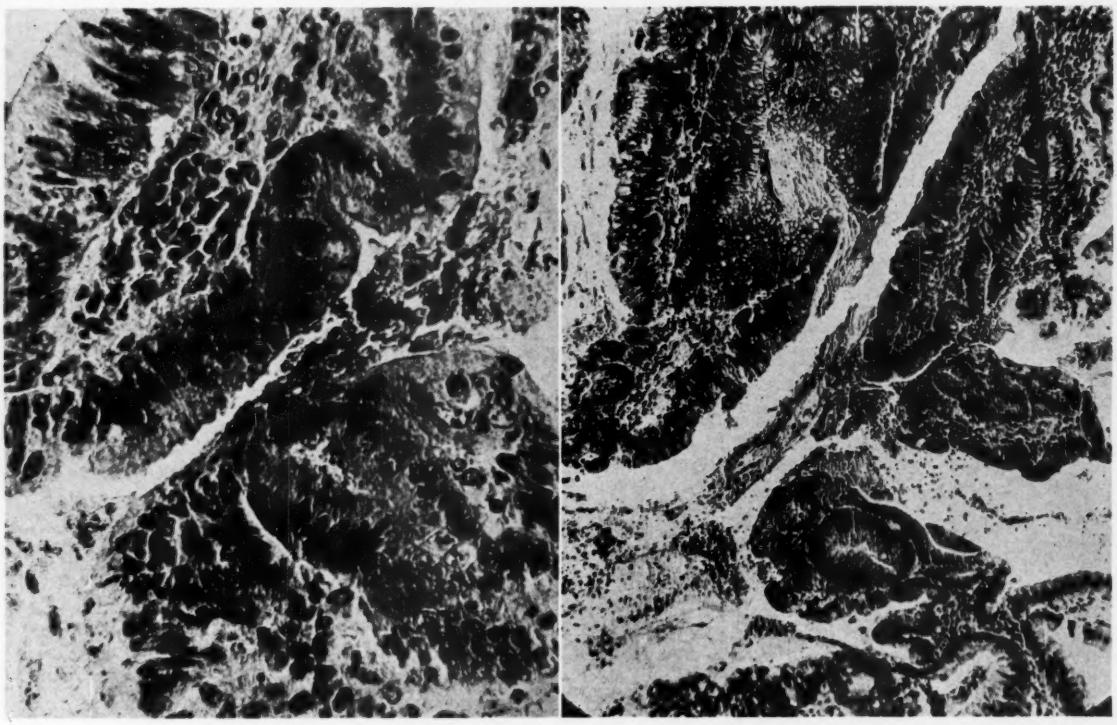

Fig. 4. Fig. 5.

Figs. 4 and 5. Microscopic sections.

Following this, it has been routine to proctoscope the patient at four-month intervals, and up to the present date, which is a total of fifty months, there is no evidence of recurrence at the site of operation, or impairment of general health.

Sixteen months later, the patient entered the New York Hospital on the Brady Urological Service, where a transurethral resection and bilateral partial vasectomy was carried out. The patient was discharged at the end of two weeks much improved.

The pathological diagnosis was as follows: Benign hypertrophy of the prostate; chronic prostatitis.

## CONCLUSIONS

Polypoid tumors of the rectum and colon are all to be regarded as precancerous

or cancerous in nature. Many cases of solitary polyp have undergone malignant change before the main objective sign of bleeding has appeared.

Many radical surgical procedures and fatalities may be avoided by the early diagnosis and eradication of the potentially malignant polyp. This can best be accomplished by the including of proctoscopy and sigmoidoscopy as a part of routine physical examinations every six months.

Because of the malignant change first appearing in the base of the polyp, the operative procedure of choice for those cases located on the posterior wall of the lower rectum is described above. The present tendency toward the electrosurgical treatment of these lesions as an office procedure is far from being adequate.

Surgical excisions under spinal anesthesia as a hospital procedure is strongly advised.

It is well to remember that malignant changes also occur in polypoid growths found in the rectum of children.

A case showing early malignant change in the mucosal base of a rectal polyp is reported with a fifty-month apparent cure to date following surgical removal.

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# CATIONIC DETERGENTS AS ANTISEPTICS

EMIL D. W. HAUSER, M.D. AND LIEUT. (J.G.) WILLIAM W. CUTTER
Attending Orthopedic Surgeon, Passavent Memorial Hospital
CHICAGO, ILLINOIS
MEDICAL CORPS, UNITED STATES NAVY

THE advantages of cleanliness in the care of wounds were observed in the earliest stages of surgery. The introduction of antiseptic procedures by Lister marked a new era in surgery. Ever since Lister's time the search for an ideal antiseptic has been going on. We have gone through various phases of new antiseptics, but each time they have fallen short of the hoped-for requirements. At the present time re-emphasis has been placed, and properly, upon the action of the living tissue as the best antiseptic action against invasive bacteria.[1] The emphasis now is on cleansing the wound with non-irritating substances like soap and water,[2] the forming of the débridement to remove the devitalized tissue, insuring adequate drainage by opening the fascial spaces, and complete immobilization of the tissue[3] with compression to prevent edema. The introduction of the sulfonamides and penicillin have again aroused the hopes for a miraculous substance to cure all infections. Some disadvantages of the sulfonamides are now well established. Penicillin has not yet been used in sufficient quantities to establish its full value; certainly it promises a great deal.

We wish to draw more attention to a new group of antiseptics, one of which we have found to be an excellent preoperative preparation as well as an antiseptic and cleansing material in the dressing of wounds, both in clearing up infection and in the prevention of infection. This disinfectant was first described by Domagk in 1935.[4] A series of chemical derivatives had been previously developed as detergents. The group is designated by following formula in Figure 1:

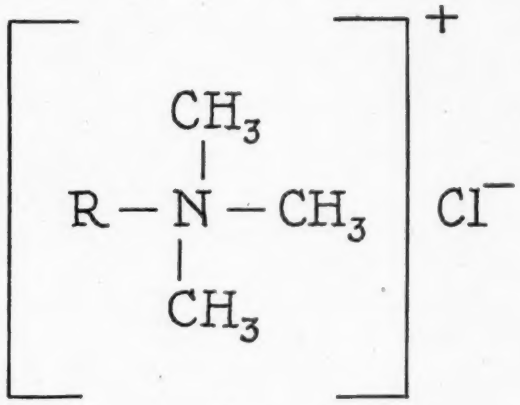


FIG. 1.

They are ammonium chloride derivatives with an R radical consisting of an alkyl radical of about 12 carbon atoms. A series of these products was developed[5] in the laboratory and tested for their bactericidal effectiveness.[6] The preparation that was finally developed as the most effective disinfectant was a water solution of a high molecular alkyl dimethyl benzyl ammonium chloride. This substance goes under the trade name of Zephiran.

Domagk first pointed out some of the physical properties: It is a colorless, odorless fluid which foams upon shaking. It is slightly alkaline to litmus. It does not precipitate with alkalis, remains clear when tap water is added, and there is no precipitate or loss of disinfectant power with the addition of acids. The substance is compatible with iodine, cocaine, ephedrine, epinephrine, procaine hydrochloride, sulfonamides and with most substances with which it is likely to come into contact. It is incompatible with soap; to get its greatest disinfectant value it must, therefore, not be combined with soap. Since Zephiran has the qualities of soap and water, and is an excellent detergent, there is no need to use soap and water.

Zephiran has a surface tension one-half that of distilled water.[7] This is of importance since the low surface tension indicates the penetrating power. In this connection, White, Collins and Newman[8] made full thickness biopsies in which the skin was prepared with the solution. In fifty-one cases in which biopsy cultures were taken from such treated skin, growth occurred in two instances; biopsy cultures of untreated skin showed growth in every case. The substance, as pointed out by Dunn,[9] is very stable; neither freezing temperatures nor prolonged exposure to heat (122°F. to 50°C.) caused any reduction of its germicidal action. Storage at room temperatures for more than eight months caused no alteration in its germicidal properties.

Zephiran is an emulsifier and a detergent and like the other substances which have a similar chemical structure, of quaternary ammonium salts, has important interface modification properties. Long before their bactericidal action was known they were used as emulsifiers, detergents and wetting agents. In preparation of the skin for surgery, these substances, as Walter[10] has demonstrated, possess a detergent, karatolytic, emulsifying and emolient action. The cleansing action is evident when it is used to wash dirt and grime from the hands; it is more effective than soap and water for the same length of time. Tests to compare detergency values have been made, using Zephiran and similar products against soap solutions. Soiled wool cloths were washed, one with soap and water, and the other with Zephiran solution. The reflection of light from the cloth was then measured. The amount of reflectance was then expressed in percentages. The

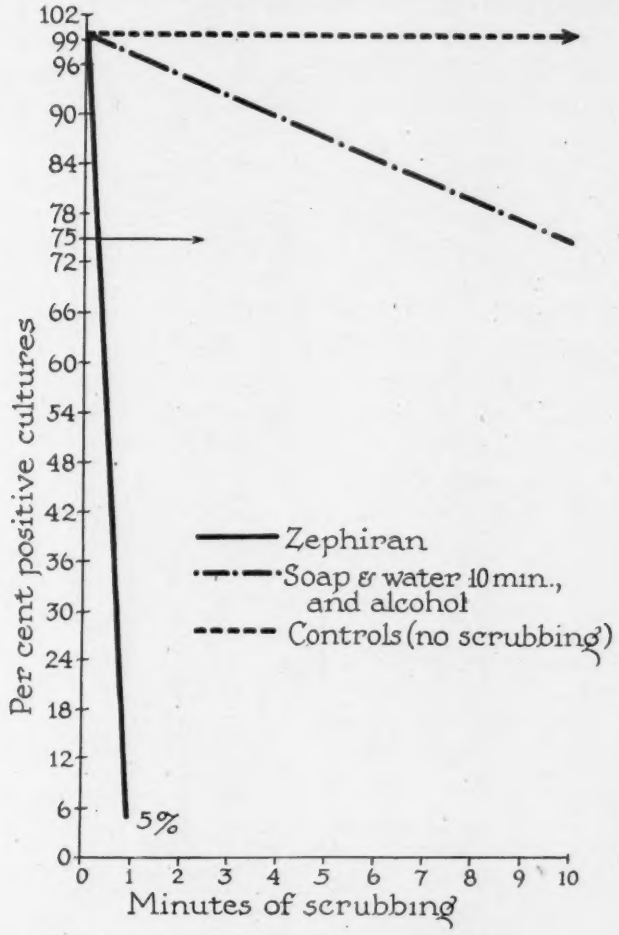


Fig. 2.

comparative study showed that .03 per cent Zephiran with the chemical formula—alkyl dimethyl benzyl ammonium chloride—gave 16 per cent reflectance, while .1 per cent of soap gave 8 per cent. In other words, Zephiran was seven times more efficient than the soap solution. In preoperative preparation there is a kerolytic action, as demonstrated by the detritus that occurs in washing the skin with Zephiran. The emolient action of the skin was evident when a surgical glove was worn on one hand dry, and on the other hand wet, with 1:5,000 Zephiran solution. The hand wet by the Zephiran solution was soft and smooth and remained so for several hours after the skin was dry.

In addition to the important cleansing ability of this substance, Zephiran, like the other quaternary ammonium salts, possesses high bactericidal and bacteriostatic action. Pure cultures of highly pathogenic bacteria were utilized to test the disinfectant action by Domagk[4] and his associates. They used bacteria in various media and to show that the disinfectant did not act on the culture media they used the suspension method as well as the bacterial carrier method. They recognized the importance of the difference in virulence of various bacteria. They found that in dealing with highly virulent Bacillus coli and staphylococcus, 1:200 dilution of Zephiran was required to get a germicidal effect in two and one half minutes, but with the ordinary run of bacteria they were able to get the same effect with a dilution of 1:2,500. To obtain the same effect with creosol solution dilutions of 1:100 were required. Against gram-positive staphylococcus, streptococcus and pneumococcus, the two and one-half minute effect was

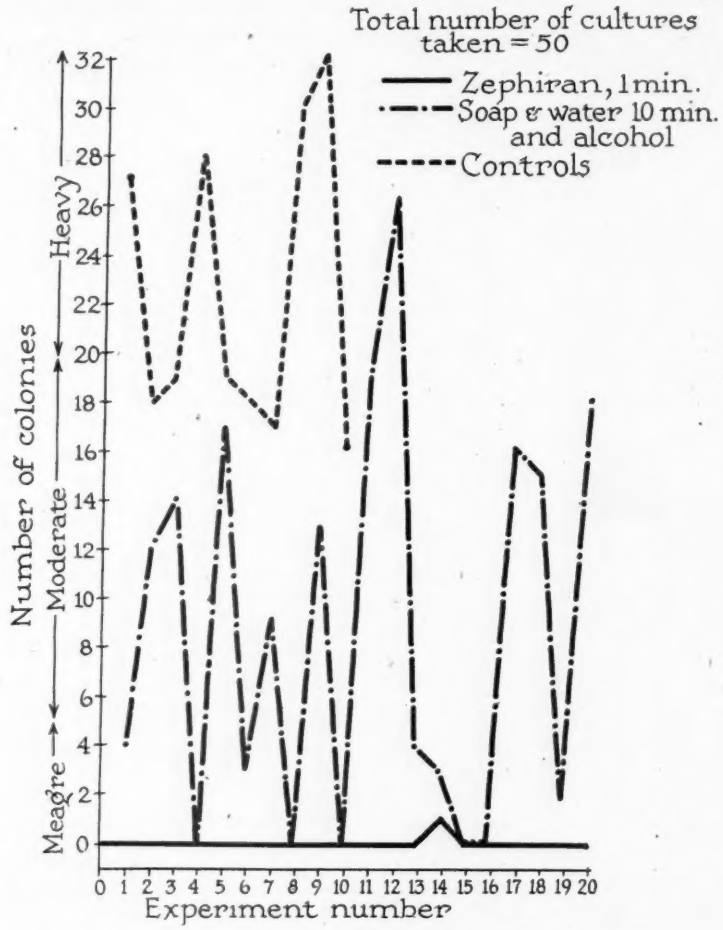
Total number of cultures taken = 50
Zephiran, 1 min.
Soap & water 10 min. and alcohol
Controls
Number of colonies
Heavy
Moderate
Meagre
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Experiment number

Fig. 3.

obtained with Zephiran diluted 1:50,000. After the two and one-half minute test they obtained no further growth in the material upon letting it stand, so that apparently it was not a bacteriostatic action. Furthermore, twenty-four hours later they added fresh cultures of the bacteria in great numbers, and found that further growth of the bacteria was prevented. Further work in determining the bactericidal effect has been carried out by other investigators. Dunn[9] reports a bactericidal effect in high dilutions of organic ammonium chlorides. He expressed the average values for the highest dilution of organic ammonium chlorides destroying the organism in ten minutes, in the following chart:

HIGHEST DILUTION OF ORGANIC AMMONIUM CHLORIDES DESTROYING THE ORGANISM IN TEN BUT NOT IN FIVE MINUTES (AVERAGE VALUES)

| Organisms | 20°C. | 37°C. |
|---|---|---|
| Staphylococcus aureus | 1–20,000 | 1–35,000 |
| Escherichia coli | 1–20,000 | 1–40,000 |
| Eberthella typhosa | 1–20,000 | 1–70,000 |
| Streptococcus hemolyticus | 1–40,000 | 1–95,000 |
| Streptococcus viridans | 1–35,000 | 1–65,000 |
| Cryptococcus hominis | 1–24,000 | 1–70,000 |

He ran a similar series of tests checking the phenol coefficient of the organic ammonium chlorides in 1:1,000 dilutions. He reported the following phenol coefficients:

PHENOL COEFFICIENTS OF ORGANIC AMMONIUM CHLORIDES

| Organisms | (1–1000 dilutions) | (F.D.A.) | |
|---|---|---|---|
| | | 20°C. | 37°C. |
| Eberthella typhosa | .. | 250 | 429 |
| Staphylococcus aureus | .. | 279 | 408 |
| Escherichia coli | .. | 160 | 358 |
| Streptococcus pyogenes | .. | ... | 272 |
| Streptococcus hemolyticus | .. | 435 | 579 |
| Streptococcus viridans | .. | 384 | 434 |

The phenol coefficients of Eberthella typhosa have also been reported by Maier and Miller,[11] who found them to be 150 at 20°C. Heineman[7] reports the phenol coefficient of the same bacteria as 275 at 37°C., Lawrence[12] as 250 at 20°C. For Staphylococcus aureus the phenol coefficient has been reported by Heineman as 275, by Maier and Miller at 200 and by Lawrence at 365, at 20°C.

Dunn[9] also showed comparative figures with the ordinary antiseptic preparations used at the present time, showing that the ammonium chloride preparations were much more effective. Another comparative study was made by Thompson, Isaacs and Khorazo,[13] who showed that the Zephiran chloride acted with much greater rapidity. It has also been demonstrated that there is some retardation of the effect in the presence of organic matter, but this is comparatively much less than other germicidal products. Its effect has been found to be decreased less by egg white media than any other disinfectant in use.[14]

A comparative study of the bactericidal effect of several types of the detergents was made by Baker, Harrison and Miller,[15] and they found that the cationic detergents exhibit a marked bactericidal effect on gram-positive organisms and a somewhat less action on gram-negative organisms, whereas the anionic detergents were germicidal only against gram-positive organisms and were considerably less effective than the cationic compounds.

In a group of experiments which we ran, the concern was with the preoperative preparation of the hands. Two to four cultures of the hands were taken each day as follows: two (or one) of our staff scrubbed in soap and water for ten minutes, following which they soaked the hands in alcohol (75 per cent), and then sterile water, in the usual manner. The other two (or one) of our staff washed their hands in Zephiran chloride for one minute without the use of brush, cloth or gauze. The hands were dried in the accustomed way and placed upon blood agar plates. Twenty

cultures of each method were taken. There were five persons included in the experiment with constant alternating of cleansing between the Zephiran chloride and the soap, water and alcohol. Two controls of each performer were taken. All of the experiments were carried out on our surgical floor in order to imitate actual conditions in preoperative preparation of the hands: caps, masks and scrub suits were donned; sterile brushes, sterile containers for the Zephiran, alcohol and sterile water were employed, as well as sterile towels for the drying of the hands.

The charts and graphs show our results. (Figs. 2 and 3.) All controls, of course, showed positive cultures; the usual manner of scrubbing with soap and water with alcohol and sterile water soaks showed 75 per cent positive cultures, and the cultures of the Zephiran chloride preparation showed 5 per cent positive cultures (one in twenty cultures). The speed of action of this coconut oil derivative is effectively shown in Figure 2, while Figure 3 shows the number of colonies in each culture.

The value of any bactericide is definitely limited by any toxic effect or irritation that it may cause to tissue. The toxic and irritative effects have been studied repeatedly. The fact that the skin is not irritated in concentrations that will act as antiseptics has been demonstrated in our experiments with the washing of the hands and in skin preoperative preparation. Experimental studies were carried out by injecting 1:2000 solution of the Zephiran (benzyl-trialkonium chloride) into the ear and into the peritoneal cavity of rabbits, and no irritation was found, nor were any toxic effects observed.[4] Prolonged oral administration of potable solutions of ammonium chloride preparation were well tolerated and daily intraperitoneal injections of dilute solutions in the guinea pig gave no deleterious effects. Installations of drops in the human eye of dilutions suitable for effective use as a bactericide produced minimal subjective symptoms.[9] The skin in various regions of the body, as well as the mucous membranes in the orifices, showed no signs of irritation after being washed with 1:1,000 dilutions of ammonium chloride preparation.[10]

We have found that repeated use by several members of the hospital staff have at no time given any irritating effect; others have found similar results, notably Dunn.[9] We found two instances on record of surgeons who could not use soap and water scrubs without getting dermatitis, who found they were able to get surgical preparation of their hands with the quaternary ammonium chloride solution without any signs of irritation. The germicidal effect for the quaternary ammonium chloride is within the range of 1 to 3,000, which is non-irritating for mucous membranes and apparently, as far as we could establish, non-irritating for vital tissue. We have been able to wash wounds with a 1:3,000 solution without irritating effect and with evidence of an antiseptic effect. The infection cleared up and healing took place. It is difficult to make comparative studies. In our opinion, Zephiran 1:3,000 is an excellent substance for cleansing infected wounds, and compares favorably with the use of soap and water. In a series of seventy-six cases reported by White, Collins and Newman,[8] ammonium chloride detergent was used as a germicide for preoperative preparation, and infection occurred in one case, or 1.3 per cent, whereas a comparative study of twenty-five cases in which 3.5 per cent of tincture of iodine was used as a disinfectant showed there were seven infected cases. We have used alkyl dimethyl benzyl ammonium chloride in solution of 1:1,000 as a routine preparation of the skin in orthopedic procedures, including surgery for internal derangements of the knee, hallux valgus and reconstruction operations, without infections. The skin was washed with the aqueous solution for at least two minutes and a tincture containing a stain was used to delineate the operative field. We have used 1:3,000

aqueous solution to cleanse chronic ulcers, osteomyelitic wounds and infected compound fractures with excellent results. We have found it a convenient and safe antiseptic in cleansing wounds in minor surgery, convenient since it saves time.

## SUMMARY

We wished to establish the value, if any, of the cationic detergents as antiseptics. We found that the primary value of alkyl dimethyl benzyl ammonium chloride, one of the cationic detergents, was its cleansing effect. Experiments seemed to confirm the findings of others, that it has a high bactericidal and bacteriostatic effect. Our clinical experiments showed that it can be safely used as a preoperative cleansing material for the surgeon's hands, as well as the operative field. We found it satisfactory for cleansing wounds in minor surgery. We have used it in cleansing infected wounds without signs of irritation to tissue. After using it over a year, we believe that alkyl dimethyl benzyl ammonium chloride, one of the cationic detergents, is a rapid, safe and effective surgical antiseptic.

PREOPERATIVE PREPARATION OF THE HANDS
ZEPHIRAN—1 MINUTE

Meagre growth: 1–5 colonies
Moderate growth: 6–20 colonies
Heavy growth: Above 20 colonies. All 48 hours

| | | | | |
|---|---|---|---|---|
| 1. | J. S. | Negative | 11. W. C. | Negative |
| 2. | W. C. | Negative | 12. D. K. | Negative |
| 3. | D. K. | Negative | 13. D. K. | Negative |
| 4. | J. S. | Negative | 14. B. S. | Meagre hemolytic Staphylococcus Albus |
| 5. | W. C. | Negative | 15. W. C. | Negative |
| 6. | D. K. | Negative | 16. H. S. | Negative |
| 7. | H. S. | Negative | 17. D. K. | Negative |
| 8. | W. C. | Negative | 18. B. S. | Negative |
| 9. | J. S. | Negative | 19. H. S. | Negative |
| 10. | D. K. | Negative | 20. W. C. | Negative |

20 Experiments: 1 (5%) Positive Culture
19 (95%) Negative Cultures

PREOPERATIVE PREPARATION OF THE HANDS
SOAP AND WATER—10 MINUTES—AND ALCOHOL

Meagre growth: 1–5 colonies
Moderate growth: 6–20 colonies
Heavy growth: Above 20 colonies. All 48 hours

| | | | |
|---|---|---|---|
| 1. | D. K. | Meagre | Hemolytic and non-hemolytic Staphylococcus albus |
| 2. | H. S. | Moderate | Hemolytic Staphylococcus albus |
| 3. | J. S. | Moderate | Hemolytic Staphylococcus aureus and albus |
| 4. | D. K. | Negative | |
| 5. | H. S. | Moderate | Hemolytic Staphylococcus albus |
| 6. | W. C. | Meagre | Hemolytic Staphylococcus albus |
| 7. | J. S. | Moderate | Hemolytic Staphylococcus aureus and albus |
| 8. | D. K. | Negative | |
| 9. | H. S. | Moderate | Hemolytic and non-hemolytic Staphylococcus albus |
| 10. | W. C. | Negative | |
| 11. | B. S. | Moderate | Hemolytic Staphylococcus albus |
| 12. | H. S. | Heavy | Hemolytic Staphylococcus albus and aureus |
| 13. | W. C. | Meagre | Hemolytic Staphylococcus albus |
| 14. | H. S. | Meagre | Hemolytic Staphylococcus albus |
| 15. | D. K. | Negative | |
| 16. | B. S. | Negative | |
| 17. | W. C. | Moderate | Hemolytic Staphylococcus aureus and albus |
| 18. | H. S. | Moderate | Hemolytic Staphylococcus albus |
| 19. | B. S. | Meagre | Hemolytic Staphylococcus albus |
| 20. | D. K. | Moderate | Hemolytic Staphylococcus aureus and albus |

20 Experiments 15 (75%) Positive Cultures
5 (25%) Negative Cultures

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Because the larynx is composed of cartilages covered with soft tissues, some closely related to the supporting structures, and others separated from it by considerable loose areolar tissue, the reaction of the laryngeal tissues to injury by the tubercle bacillus is quite different than that of the lung.

From "Tuberculosis of the Ear, Nose, and Throat," by Mervin C. Myerson (Charles C. Thomas).

# THE NEW COAGULUM-CONTACT METHOD OF SKIN GRAFTING*

## FURTHER SIMPLIFICATIONS IN TECHNIC

MACHTELD E. SANO, M.D.
PHILADELPHIA, PENNSYLVANIA

A NEW physiological method of skin grafting based on the principles used in tissue culture has been developed during the past fourteen months. A preliminary report of experiments on rats in which heparinized autogenous plasma and cell extract from the buffy coat alone, (or from the buffy coat admixed with erythrocytes) have been used as a means of promoting the immediate fixation of the graft and subsequent union by stimulation of cellular growth has previously been presented.[1] When grafts are applied after heparinized autogenous plasma has been painted on the recipient area and cellular extract on the undersurface of the graft, a coagulum forms within a few minutes which fastens the graft in place, rendering unnecessary either sutures or special retention dressings. As a rule, vascularization of the graft follows within forty-eight hours. In the original technic, the animal's blood was centrifuged, the plasma separated and the cell extract made immediately before the grafting was undertaken. These technical procedures, simple as they are, offer certain difficulties in clinical application so the technic has been modified in the further animal experiments being reported in this paper, using guinea pigs instead of rats.

A number of guinea pigs are bled from the heart (using 1 cc. of a 0.1 per cent heparin solution to 5 cc. of blood to prevent clotting), the blood immediately centrifuged and the plasma pooled. One and a half cc. of the pooled plasma are transferred to 5 cc. vaccine vials and dried.*

* We wish to acknowledge our indebtedness to Dr. John Henderson, of Sharp & Dohme, who has cooperated in the drying of the plasma.

Similarly, 1.5 cc. of the buffy coat suspension to which many erythrocytes may adhere are placed in cotton-stoppered vials and permitted to dry spontaneously in the refrigerator. After drying, the vials are sealed with rubber stoppers and covered with celloidin. This dried material remains potent either at room temperature or in a refrigerator for at least two months. Before use, the desiccated plasma and the buffy coat are each dissolved in 1 cc. of sterile distilled water. The plasma is dissolved with as little agitation of the vial as possible while the desiccated buffy coat is vigorously shaken. Small particles of the undissolved buffy coat material do not prevent successful grafting.

The usual preliminary requirements for any successful grafting are desirable. The surface to be grafted should be clean and free of necrotic tissue. If the recipient area has been denuded immediately before grafting, all the bleeding vessels must be tied with silk sutures. On animals hot saline compresses are usually sufficient to stop bleeding. After the recipient area has been prepared, the donor area is shaved and washed with soap. The size of the graft is then outlined by cutting a piece of cellophane the required size and shape; the thickness of the skin graft depends on the end results desired. Thin, medium and thick split grafts as well as full thickness grafts may all be used successfully with the method. The graft is placed denuded side up on sterile gauze without rinsing or wetting the graft with physiological saline as it washes out the desirable autogenous cell juices which aid in promoting the formation of the clot and cell

* From the Department of Pathology, Temple University Hospital and School of Medicine, Philadelphia.

growth. A thin layer of the plasma is brushed on the recipient area. In the same way the cell extract is painted on the underside of the graft. The graft is then quickly turned and fitted into place with delicate forceps. The guinea pig, which up to this point has been under ether anesthesia, is then given 0.2 cc. of nembutal intramuscularly to keep it quiet for a few hours. The coagulum "sets" in five to ten minutes.

In animals, in order to avoid contamination of the field and removal of the graft by clawing or biting, a protective dressing of boric acid ointment is placed over the graft. This is held in position by a cork ring and a binder having two openings for the forelegs. This binder is then sewed snugly together over the back of the animal. Either the chest or back may be used for grafting but we have found the back more satisfactory for the guinea pig. As in the previous experiments on rats, vascularization of the graft was usually well established within forty-eight hours.

Grafting with autogenous plasma and cell extract has been successful in a series of ten human cases using both thin split skin and full thickness grafts. A trial of this modified technic using pooled dried plasma and cell extract is in progress and the results will be reported in detail later.[2]

## SUMMARY

1. Pooled, heparinized dried plasma and dried cell extract have been used instead of fresh autogenous plasma and cell extract in experimental skin grafting in guinea pigs.

2. A discussion of the principles and technic is presented.

3. The method obviates the necessity of stitches, dressings or other protective measures.

4. The method has all the advantages of the previously described method plus the convenience of having the plasma and cell extract immediately available for use anywhere at any time.

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# BURN THERAPY

## CONSIDERATION OF BURNS IN INDUSTRY

ALMA DEA MORANI, M.D.
Assistant Clinical Professor of Surgery, Woman's Medical College of Pennsylvania
PHILADELPHIA, PENNSYLVANIA

THE expansion of industry due to the war effort has given greater significance to the consideration of burn therapy. First, the percentage of industrial burns is higher; second, there are fewer available industrial physicians. It is the duty, therefore, of all physicians to obtain adequate training in the treatment of burns in order to fill the needs of industry and of civilian practice.

The best estimates available from fire insurance companies indicate that approximately 10,000 lives are lost each year as a result of burns or accidents directly or indirectly due to fires. In 1937, the Census Bureau reported 1,688 persons killed in conflagrations, and 6,240 persons who lost their lives due to accidental burns of which 774 fatalities took place in automobiles. An interesting fact is that almost half of all fire deaths involve children under fifteen years of age or persons over seventy. Nearly twice as many girls of five to fourteen were burned to death as were boys of the same age, which may be interpreted as evidence of the inflammability of girls' clothing.

In 1941, statistics reported 7,800 deaths from burns of all types throughout the United States.

In the State of Pennsylvania alone, the first nine months of 1941 showed 5,026 burns and scalds reported to the National Safety Council. This is an average of about 558 burns per month in industry. In 1942, the average rose to 599, an increase of forty-one burns per month. Burns and scalds accounted for 4.5 per cent of all industrial accidents in Pennsylvania.

### CLASSIFICATION

The etiological classification of burns is familiar to us all as: thermal, chemical, ultraviolet, electric, *x*-ray and radium.

Pathologically, burns are divided into first, second and third degree, depending upon the depth of skin damage. Obviously, this is a gross division for it is apparent that this classification offers no sound basis for the treatment of burns, because burns of any degree present special problems dependent upon the location, surface area and type of tissue involved. It follows that burns of the third degree offer the complicating factor of depth of penetration since the treatment may vary depending upon the amount of fascia, tendons, muscles or bones destroyed.

It is common opinion that burns of the first degree will usually prove fatal when two-thirds of the body surface is involved, and that burns of one-third of the body surface offer a poor prognosis and may also prove fatal. All burns affecting one-tenth or more of the body surface must be looked upon as serious and ideally should be hospitalized for adequate treatment.

In the estimation of the burn area involved, the chart worked out by Berkow is a useful table and helps determine the prognosis of the burned individual. (Fig. 1.)

The only distinction we make between burns and scalds is to note that moist heat, above a temperature of 125°F., will produce a scald, while dry heat of a temperature of 140°F. or above, will produce a burn. Boiling water or other liquids, superheated steam and molten metals produce scalds. Molten metals

are also known to produce second and third degree burns. Fluids, such as oil, which boil at higher temperatures than water produce increasingly severe burns. Since the heat of solid bodies is usually greater than that of liquids, the former will produce very deep burns, while liquids flowing over a large surface will cause more extensive, though comparatively superficial lesions. The pathology and treatment of burns and scalds is relatively the same.

### GENERAL CONSIDERATIONS OF THE BURN PROBLEM

Obviously, the clinical picture of a burn depends chiefly on the extent of the surface involved. Minor burns cause only local reaction and require only local treatment. Extensive burns result in general reactions, the most important development being recognized as shock.

In the treatment of extensive burns, the surgical principles involved are the same regardless of the type of burn we are dealing with. The aims of the physician appear to be threefold: (1) Prevent and combat shock; (2) convert the open, contaminated wound into a clean wound, and (3) cover the open wound with the simplest possible protective dressing.

### MANAGEMENT OF BURN SHOCK

It is well recognized in the treatment of burns that first efforts should be directed toward the prevention or limitation of shock, and therefore there should be no *local treatment* before resuscitation of the patient. In all cases of severe burns, the patient sustains some degree of shock, and according to the severity of the condition, manifests some or all of the symptoms. It is now well understood that shock following burns is different from traumatic or hemorrhagic shock. The cardinal feature of burn shock is the *loss of plasma* both from the burned surface and by exudation from the capillaries into the surrounding tissues. This loss commences early (within two hours) and is progressive in character. Diminution of blood volume with lowering of the blood pressure, hemoconcentration, and increased viscosity of the blood are natural results of this phenomenon. As Blalock[15] has shown, there is a marked shift of plasma fluid from the intravascular to the extravascular spaces, resulting in an acute loss of circulating blood volume.

### GRAPHIC DESCRIPTION OF SHOCK

Observers agree that primary shock can be severe and is not necessarily dependent upon the extent of the area burned. For this *primary shock*, morphine is an aid. For an adult, ¼ gr. dose is the usual requirement for relief of pain and fright. Secondary shock is due to loss of body fluids from burned surfaces, and still more important, loss of fluids into subcutaneous tissues. The latter is comparable to the bleeding that occurs into a crushed limb; and it is this secondary shock with which we are so vitally concerned. *Experimentally, it is estimated that half of the fluid shift occurs within the first six hours.* Authorities now consider the external application of heat undesirable on the basis that the resultant cutaneous vasodilatation causes a peripheral pooling of blood, decreasing venous return, thus contributing to further circulatory collapse. In burn cases, therefore, we strive to maintain the body temperature within physiological limits.

Elkington,[26] Wolff and Lee, of Philadelphia, reported a 20 per cent loss of body plasma volume within fifteen minutes of the occurrence of a second and third degree burn of 20 per cent body surface. It is evident, therefore, that just as in the early surgical repair of ruptured peptic ulcer we must attempt to replace plasma loss in severe burns within those first six golden hours.

The most pressing need in such cases is for dilution of the blood with a fluid which will not readily pass into the tissue spaces, and plasma constitutes the ideal physiological medium. In other words, the plasma which has literally run out

of the hyperpermeable capillaries, must be replaced by plasma, and such replacement should occur within the first six hours. Only when plasma is not available should other fluids be used for infusion purposes. In such instances saline solution, plus 5 per cent glucose, may be of temporary value in building up the circulatory volume; but the benefit to be derived is necessarily transient, since the added fluid is rapidly lost through the hyperpermeable capillary walls. Transfusions of whole blood possess the disadvantage that while they will restore the blood volume in some measure, they aggravate the existing hemoconcentration. As a general rule, whole blood should be given only in the early treatment of burns when actual hemorrhage has occurred, or in the treatment of the anemia which develops about the fifth or sixth day, or weeks later. (Table 1.)

Table 1*

MNEMONIC SUMMARY OF BURN SHOCK

S—*Seepage* through the capillaries following capillary dilatation causing loss of plasma.

H—*Hemoconcentration* with decreased blood volume and blood flow and increase in hematocrit and hemoglobin.

O—*Oxygen want* or anoxemia of the tissues.

C—*Cardiac output decreased* because of loss of plasma by seepage into the tissues.

(K) *Potassium salt increase* with decrease of sodium, chloride, and proteins.

Hemoconcentration is the most important diagnostic and prognostic sign of shock in uncomplicated burns.

* From Harkins' "Treatment of Burns" (courtesy of Charles C. Thomas).

## SUMMARY OF NATURE OF BURN SHOCK

With severe shock, administration of oxygen and of suprarenal cortical hormone is helpful. Cortical extract in adequate dosage is believed to decrease capillary permeability, thus shortening the period during which protein leaks through the capillaries, and cutting down the loss of plasma, sodium and chloride. If possible, fluid should be administered by mouth, but reliance should not be placed upon this for replacement of plasma loss.

The plasma should be given in divided doses, approximately 500 cc. at a time. Subsequent administration of plasma may be determined on the basis of hematocrit readings, as suggested in Table 11:

Table 11

PLASMA ADMINISTRATION

General treatment includes the control of shock, toxemia and infection. Large doses of plasma are essential in treating burn shock. The dosage of plasma can be calculated by one of the three following methods suggested by Harkins:[33]

1. Give 100 cc. of plasma for every point the hematocrit exceeds the normal of 45.
2. Give 40 cc. of plasma for every point the hemoglobin goes above 100.
3. First aid formula. Give 40 cc. of plasma for every per cent of the body surface involved by a deep burn as calculated by the Berkow method.

## ASEPSIS

The keynote of local burn therapy we believe to be the conversion of the open, contaminated burn surface into a clean wound. For mechanical cleansing, we advocate the use of sterile washcloths, and insist that the surgeon and assistants use aseptic technic as carefully as with any major surgery. Admitting that all burns are contaminated wounds, we believe that infection can be prevented in burns if the patient is seen promptly after injury and has not received extensive or prolonged first-aid.

## DÉBRIDEMENT

Reference to this procedure in deep or dirty burns has been aptly called a two-edged sword. Conservative surgeons hesitate to remove all apparently dead skin because of the danger of removing viable islands of skin. Bolder surgeons remove all dead or necrotic skin and believe that in so doing they spare the patient the intoxication from its absorption, to speed healing. Débridement, therefore, should be used only after careful judgment and with extreme caution.

One word about the importance of immobilization and complete rest for the burned areas is not amiss, for it has been repeatedly emphasized by experience in war and industrial disasters, that severe burns merit the same early and prolonged

immobilization that one would give a compound fracture. Hence military surgeons advocate the use of plaster casts in the transportation of severely burned patients.

### HEALING OF BURNED SURFACES

In the loss of partial skin thickness, complete regeneration of epithelium takes place in ten, twelve or fourteen days, and healing of the burned area should be complete when the primary dressing is removed. The surgeon must keep in mind that in the loss of whole thickness of skin, no dressing can bring about regeneration of the epithelium; for reformation of covering skin can come only by ingrowth from the periphery or as a result of skin grafting. To await spontaneous healing when a denuded surface is more than two square inches in area, is only to delay recovery. The physician must possess the courage of his convictions and do repeated surgical débridement or skin grafting when the occasion demands.

### LOCAL TREATMENT OF BURNS

The third consideration in burn therapy, involves covering the wound with the simplest possible protective dressing, in order to accomplish the following: (1) Protect the burn from constant danger of reinfection; (2) not fix or destroy any part of the viable skin or subcutaneous tissue; (3) exert a uniform moderate pressure over the burned surface and provide for the drainage of the exuding serum, until it is checked by pressure or the normal process of coagulation; (4) be easily removable if infection develops underneath the dressing, or if skin grafting is required.

The fact that we have so many types of local burn treatment is evidence of the lack of the complete efficiency of any one of them. Following table lists only a portion of the many burn treatments advocated in recent years. (Table III.)

In small, superficial burns that are properly cleansed, it makes little difference which method is used locally. Any one of the various tannic acid preparations, antiseptic dyes, or ointment dressings, will give satisfactory results when properly applied.

TABLE III
LOCAL BURN THERAPY

1. Tannic acid 5%
2. Tannic acid jelly
3. Tannic acid silver nitrate
4. Gentian violet 1%
5. Gentian violet silver nitrate
6. Triple dye
7. Ferric chloride
8. Tea
9. Ink
10. Olive oil
11. Unguentine
12. Mercurochrome
13. Brilliant green
14. Acriflavine
15. Dichloramin-T
16. Dakin's solution
17. Amyl-salicylate
18. Aluminum acetate
19. Carron oil
20. Dry dressings
21. Adrenalin packs
22. Horse serum
23. Picric acid
24. Acetic acid
25. Débridement
26. Cod liver oil
27. Viscopaste
28. Gadoment
29. Camphorated oil
30. Paraffin
31. Tulle grass
32. Plaster casts
33. Dextrose, sucrose solution
34. Alcohol dressings
35. Bismuth subnitrate gauze
36. Electrosurgical brush
37. Sodabicarb. paste
38. Zinc oxide and wax paper
39. Vaseline gauze
40. Foille
41. Saline baths
42. Sulfhydryl solution
43. Bunyan envelopes
44. Pressure dressings
45. Sulfanilamide powder
46. Sulfathiazole suspension
47. Sulfathiazole ointment
48. Sulfadiazone ointment
49. Sulfadiazone methylcellulose
50. Sulfadiazine film

*Tannic Acid Treatment.* This is still the official method of local therapy for burns and scalds with the British Emergency Medical Services and with our own Naval Forces. It has been used for many years with fairly good results and has stood the test of time. A freshly made 5 per cent tannic acid spray, repeated at 15-minute intervals, will form a satisfactory coagulum although some condemn this slow tanning because of toxic absorption. Tannic acid jellies or pastes of 5 to 10 per cent strength are commercially available and are valuable for office and industrial practice. Tannic acid 5 per cent and silver nitrate 10 per cent combined, make a valuable addition to this type of treatment, and in our experience its value has been demonstrated for it

shortens the period of eschar formation. (Fig. 2.)

*Gentian Violet.* A 1 per cent solution is

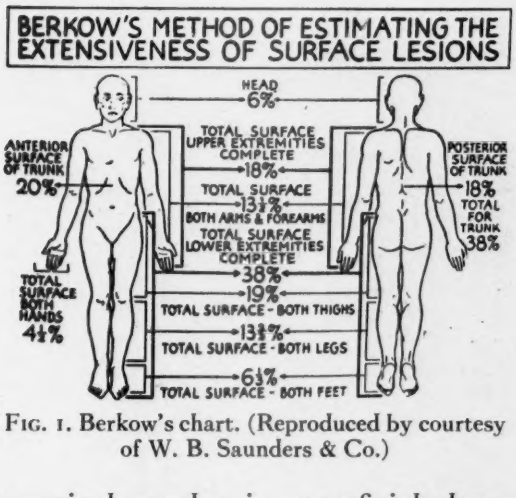

BERKOW'S METHOD OF ESTIMATING THE EXTENSIVENESS OF SURFACE LESIONS
HEAD 6%
ANTERIOR SURFACE OF TRUNK 20%
TOTAL SURFACE UPPER EXTREMITIES COMPLETE 18%
TOTAL SURFACE BOTH ARMS & FOREARMS 13½%
TOTAL SURFACE LOWER EXTREMITIES COMPLETE 38%
TOTAL SURFACE BOTH HANDS 4½%
TOTAL SURFACE - BOTH THIGHS 19%
TOTAL SURFACE - BOTH LEGS 13½%
TOTAL SURFACE - BOTH FEET 6½%
POSTERIOR SURFACE OF TRUNK 18%
TOTAL FOR TRUNK 38%

Fig. 1. Berkow's chart. (Reproduced by courtesy of W. B. Saunders & Co.)

of particular value in superficial thermal injuries showing evidence of infection when first seen, or in burns of more than forty hours' duration. It is especially useful in burns of the hands, feet, perineum, and deep burns encircling extremities in the region of joints. The antiseptic property of gentian violet seems to be enhanced by the combination with silver nitrate, and a thin, dry, pliable eschar results. (Fig. 3.)

*Triple Dye Method.* Aldrich[3] advocates this method, where as fast as one coating dries, another is applied until a definite eschar is formed, which resembles a piece of purple leather with a gold, green sheen, and affords a more complete antiseptic action with mild powers of escharosis. Theoretically, this combination of dyes is specific against both gram-positive and gram-negative organisms, and when exposed to the air relative sterility should be easily maintained. We find this method desirable with burns of genitalia, hands, and encircling burns about the joints.

*Saline Bath Treatment.* English clinicians favor the saline bath treatment for severe or extensive burns. Here the patient is kept slung in a saline solution bath which is maintained thermostatically at body temperature for one to six hours or longer. The patient is then placed on sterile sheets, in a heated, tented bed, and the burns compressed with thick layers of gauze soaked in physiological saline. Pre-

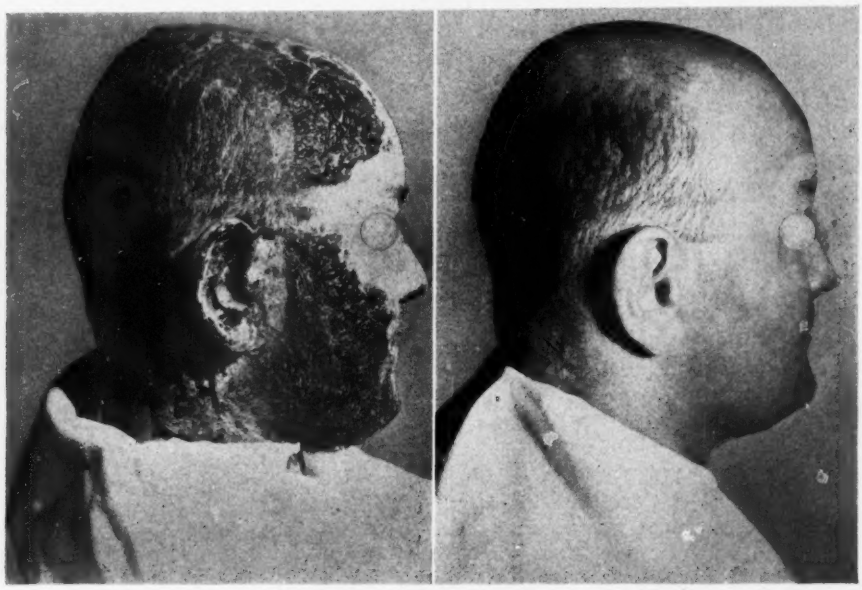
Fig. 2. E. H. Example of tannic acid therapy on second and third degree burns of 33 per cent of body surface.

liminary covering of the burned area with tulle grass, over which the saline dressing is laid, offers certain advantages. The dressings should remain wet or pain will ensue. For burns about the joints, frequent immersions are beneficial. In burns of the face, a mask kept wet with saline should be worn, while eyelids and hairy areas should be smeared with sterile vaseline.

*Pressure Treatment.* Dr. Koch[36] advises this simple, but effective treatment. *Following débridement,* the burned wound is covered with strips of vaseline gauze and pressure is applied by means of fluffed gauze or mechanic's waste held in place by elastic bandages or stockinet. This dressing is not disturbed for ten or twelve days, and when removed, first degree burns will be found to have healed. Any necrotic portions of skin are then excised and skin grafting follows. This method offers the advantage of a minimum change of dressings and nursing care. It was used ad-

vantageously on many victims of the Boston "Cocoanut Grove" fire, and appears to be the most desirable local treatment yet evolved. (Fig. 4.)

satisfactorily used 3 per cent sulfadiazine solution in 8 per cent triethanolamine, on 116 burn cases, and has now altered his formula to include methylcellulose which



A B

Fig. 3. A, flash burn following ignition of zirconium; treatment with gentian violet and silver nitrate therapy; B, result three weeks later.

Fig. 4. Example of vaseline gauze pressure dressings in extensive burn. Note thickness of dressings deemed necessary.

*Chemotherapy.* Practically every combination of sulfonamides as solutions, suspensions and ointment have been reported by various workers with good results. Sulfanilamide or sulfathiazole, either in powder or microcrystalline form, may be dusted on the burn and followed with pressure dressings kept moist with saline solution. The use of 5 per cent sulfathiazole ointment or emulsion is ideal for burn areas not suitable for tanning. In 1941, Pickrell is a film-forming compound and has the advantage of forming a rapid, artificial layer resembling cellophane over the burned surface. Apparently there is no toxicity and the film is antiseptic, therapeutic and translucent. We have been pleased with this method of treatment in practically any region except the face. Sulfa-film or sulfanilamide incorporated in cellophane-like tissue, is the newest departure in burn therapy. This pliable film

is cut to fit the burn surface and makes an excellent bacteriocidal first-aid dressing, which seems desirable and appropriate for burns received at the battle front. (Fig. 5.)

Thus a review of modern burn therapy leaves even the experienced surgeon wondering which method of local treatment to select. In an attempt to help clarify this situation the following table is offered (Table IV):

TABLE IV

CHOICE OF LOCAL BURN THERAPY

| Body Portion | First Degree | Second Degree | Second and Third Degree |
|---|---|---|---|
| Face | Vaseline Dressing<br>Sulfadiazine Ointment<br>Triple Dyes | Vaseline Dressing<br>Pressure Treatment (Koch)<br>Saline Packs<br>Sulfadiazine Emulsion* | Vaseline Pressure Treatment<br>Saline Packs |
| Hands | Boric or Vaseline Paste Dressings<br>Sulfonamide Pastes<br>Dye Therapy | Vaseline Dressings<br>Pressure Treatment<br>Saline Baths | Vaseline & Pressure Dressings<br>Saline Baths |
| Extremities | Sulfonamide Pastes<br>Triple Dyes<br>Tanning Methods | Pressure Treatment<br>Sulfonamide Pastes<br>Tanning Methods<br>Saline Baths | Pressure Treatment<br>Saline Baths |
| Trunk | Tannic Acid—Silver Nitrate<br>Sulfadiazine Spray<br>Triple Dyes<br>Vaseline Dressings | Tannic acid and Silver Nitrate*<br>Sulfadiazine Spray<br>Triple Dyes<br>Pressure Dressings | Tannic Acid-Silver Nitrate*<br>Pressure Dressings<br>Saline Baths |
| Perineum and Genitalia | Boric Ointment<br>Sulfonamide Pastes or Emulsions*<br>Dye Therapy | Sulfonamide Pastes or Emulsions*<br>Saline Baths | Sulfonamide Pastes or Emulsions<br>Saline Baths |

* The treatments indicated by asterisks were recommended by the National Research Council in January, 1942.

Statistics indicate a great preponderance of hand burns in industry and these require special consideration. Hand burns caused by scorching with very hot objects, molten metals, or flames are usually small but deep. Treatment of these patients is generally conservative, and briefly, consists of cleansing with soap and water, irrigations with boric acid or saline solutions, dry sterile dressings or sulfonamide ointments, followed by properly fitting splints for immobilization. If infection develops, more drastic treatment is required and frequently surgical resection of necrotic tissue is necessary. When the burns are deep and show no tendency to epithelialize, early skin grafting is advised as soon as a clean, granulating surface is obtained.

### TREATMENT OF BURNS IN INDUSTRY

With limited industrial thermal burns in which the area of involvement does not exceed 10 to 15 per cent of the total body surface, and the depth of penetration is not excessive, sterile petrolatum gauze can be utilized following the usual preparation of the area. This is satisfactory especially in burns involving the extremities, and should be fortified with copious gauze dressings snugly applied to exert pressure. In minor industrial burns it is advisable to use 5 per cent sulfathiazole or sulfadiazine ointment, or a mixture of the two.

ELECTRICAL BURNS

Here there are two factors to be considered: the burn itself and the effect of

Fig. 5. Illustrating the sulfadiazine methyl cellulose treatment of burns. Note the cellophane-like appearance at the edges of the wound.

the electrical current. Actually the amount of local injury is determined by the degree of local contact, which results in: (1) *Electric current mark;* usually circular or elliptical areas, varying in size from a pinhead to a pea; color: grayish white; (2) *electrical necrosis;* this is more severe, more extensive in area then the current mark. The third week is the danger period from severe hemorrhage due to degenerative changes in the artery walls.

When superficial burning complicates electrical necrosis, the clinical picture becomes one of a severe burn with a painful, red area of reaction around the wound, and the patient exhibits the usual toxic signs.

Blood vessels are very good conductors and this may explain the frequency of thrombosis remote from the place of burn contact. Deep electrical burns are particularly serious and can be called fourth degree in some instances. They may be followed by extensive separation of involved tissues, days or even weeks later. There is also the danger of massive and even fatal hemorrhage. The only treatment for the electric current shock is immediate and continuous artificial respiration. The local treatment of the electrical burn area oscillates between vaseline gauze dressings or early débridement, followed by immediate skin grafting. Antitetanus antitoxin should always be administered, as with any severe burn.

CHEMICAL BURNS

With these burns, copious amounts of water are applied in great haste to wash off any acid or alkali solutions. The only exception to this rule is in the case of lime burns, which should *not* be treated with water until the excess of lime dust is removed. Obviously, it is important to ascertain the exact nature of the offending chemical so that intelligent treatment may be given.

*Acid burns* should first be neutralized with a mild alkali (5 per cent sodium bicarbonate solution), while alkaline burns may be rinsed with weak acid (vinegar, 3 per cent acetic acid). This should be done before starting any other active treatment, with the caution that damage can be produced by the neutralizing agent itself, when used carelessly. Recently the use of a phosphate solution buffer has been advised to neutralize both acid and alkali burns since it gives a neutral molar solution (ph7) which remains in the physiologic range. Application of this agent is even considered in eye burns, although a transient conjunctivitis may result. Obviously, a more dilute solution of the phosphate buffer will eliminate this hazard but also diminishes the effectiveness of the buffer.

Carbolic acid burns are best neutralized by alcohol and ordinary rubbing alcohol is adequate for this purpose. After this

local treatment, a sterile dressing is applied and the physician must select future therapy with careful judgment, since chemical burns are usually very deep and tend to heal slowly. Convalescent care consists chiefly of the prevention of infection by the application of wet antiseptic dressings or sulfanilamide powder; and when infection is controlled and healthy granulations appear, a properly selected skin graft is desirable.

*Magnesium burns* (molten magnesium) have lately caused considerable concern in industries, for they are prone to form very slow-healing granulomatous ulcers.

Metallic magnesium interferes with normal cell physiology and causes interferences with normal repair processes. Prompt removal of metallic magnesium by excision of burnt skin under local anesthesia is required for healing. A 5 per cent sulfanilamide unguent follows denudation of the area.

### X-RAY AND RADIUM BURNS

The frequency of these burns among physicians is so well known that no detailed discussion is necessary. Once an *x*-ray or radium burn is established as a deep ulceration, the problem of treatment is essentially surgical and local application of any single medication should not be carried on too long, for the ever present danger of malignant change needs to be kept in mind. Excision and plastic resuturing can be done with small lesions, while whole thickness or pedicle grafts may be required in the plastic repairs of large, deep *x*-ray burns.

*Ultraviolet ray burns* are extremely common in the popular sunburn, and respond well to local treatment with boric acid or butesin picrate ointments. Some general treatment may also be required; but sunburns are rarely serious, as they are usually first degree burns. A few ultraviolet light burns have been reported and these are serious, as they cause a large surface damage and are frequently dangerous out of proportion to their depth. Treatment varies with the judgment and experience of the individual surgeon, with special attention to the general care of the patient.

*Gasoline burns* are notorious in presenting a larger incidence of complications such as cellulitis, lymphangitis, slow healing scars and deep contractures. Statistics show that women are the chief victims of kerosene and cleaning fluid burns, and these require the same general treatment given chemical burns.

*Eye burns* merit special attention. With acid or alkali burns, lids should be held open and irrigated with either a weak neutralizer or copious amounts of cold boric acid or even plain water. A few drops of olive or mineral oil are then dropped into the eye, or a single instillation of 2 per cent butyn ophthalmic ointment. The patient must be warned not to rub the eye, as severe corneal injury may result. If corneal ulceration is suspected, a consulting ophthalmologist should be called. Instillations of atropine for papillary dilatation are often advised. No dressing should be used, and the eye should be flushed free of secretions. In eye burns produced by caustic soda, a neutralizing solution of 5 per cent ammonium chloride has been found to be most effective as an irrigant.

### CONFLAGRATION TYPE BURNS

These burns tend to be extensive and fatal due to the primary shock and the frequent complications which include laryngeal and pulmonary edema from inhalation of smoke and gases. Autopsies indicate that all persons trapped in a burning atmosphere may inhale hot air, flames or poisonous gases, and must be observed very closely. Hospitalization becomes, therefore, imperative, because of the high incidence of immediate pulmonary complications. These types of burns may produce no skin lesions and yet severe damage to the trachea and lungs may ensue and rapidly cause edema, pneumonia and death.

Concerning any type of burn, when the acute stage is over and the paramount

issue of preserving the patient's life is settled, the ensuing care of the burn becomes primarily a matter of restoring function and appearance of the part. When a granulating surface presents itself, all efforts should be directed toward making it heal as rapidly as possible without surgical measures. However, when these efforts fail or when the progress of the burn indicates that the natural processes at best will take too long, early plastic treatment of burns is indicated and skin grafting should be resorted to. Here the use of Padgett's[56] dermatone cannot be too highly recommended. We believe that with careful technic, split skin grafts are successful in 80 to 90 per cent of all cases and give very gratifying results.

Finally, the importance of maintaining an adequate diet throughout the lengthy convalescent period of all severe burns must not be overlooked, as the biological factors which influence burn healing are the same as those applicable to wound healing.

## CONCLUSIONS

1. Statistics reveal an increase in the number of industrial burns.

2. In all severe burns there should be no local treatment before resuscitation of the patient from shock.

3. Burn shock treatment is well standardized and the high points have been outlined.

4. Every burn should be converted from an open, contaminated wound to a clean wound.

5. Concerning the local therapy of burns, no one form of treatment can be considered ideal.

6. The treatment selected, therefore, depends on: (1) Size and location of the burn; (2) type and depth of the burn; (3) amount of the time elapsed since its occurrence; (4) amount of infection present or expected; (5) experience and judgment of the surgeon, and (6) availability of material to be used.

7. Present trends seem to indicate that the methods of tanning and the use of antiseptic dye technic will soon be abandoned.

8. The methods which seem to have the best chance of surviving at the present are: (1) Pressure dressings with or without the use of vaselinized gauze, and (2) chemotherapy.

9. Sulfonamide therapy should be routinely employed in all burn cases of more than slight extent. Sulfadiazine is the drug of choice.

10. In the general care of the patient a high caloric high protein diet *with* adequate vitamin intake is recommended.

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# A METHOD OF TREATING NERVE ENDS IN AMPUTATION STUMPS

MAJOR JOHN T. BATE
MEDICAL CORPS, ARMY OF THE UNITED STATES

SEVERAL years ago, it became our duty to care for the injured employees of a large railroad. Among these were several patients who complained bitterly of their stumps. One man with an amputation at the lower third of the humerus had had several operations by an excellent neurosurgeon, including repeated excision of nerves, and sympathectomy, but continued to complain of intolerable pain. Leriche, in his monograph on pain, reports many similar cases and suggests various operations on the sympathetic system to relieve this pain.

In his monograph on amputations, Major General Norman T. Kirk discusses the various methods of treating nerves in the amputation stump. His modification of the alcohol injection method has proved satisfactory, but he found that painful neuromas, particularly in the arm, sometimes follow this form of treatment and may require further operative treatment from time to time. Recently he has used the suggestion of Col. W. L. Keller that a cone with the apex upward in the nerve end be burned with a sharp-pointed actual or electric cautery. He reports that sufficient cases have not yet been observed to evaluate results.

In our practice, when the peripheral nerves frequently were injected with absolute alcohol at the time of amputation we noted the growth of neuromas at the site of amputation. These have been very painful and seemed occasionally to contribute to a tendency to develop edema and ulceration at the site of the scar.

Since electric current desiccation of small skin tumors is followed by practically no pain, it occurred to us that desiccation of the peripheral nerves with either a bipolar or monopolar electric current might give improved results.

This method was used in four cases: two cases of amputation of the leg seven inches below the knee performed for severe crushing injury to the foot and ankle; one reamputation of a painful slightly ulcerated stump originally amputated seven inches below the knee because of severe trauma to foot and ankle; and one Gritti-Stokes type amputation performed for impending gangrene of foot caused by progressive occlusion of the arteries of the leg in a fifty-five-year old woman, apparently caused by arteriosclerosis. The severed nerve was pulled down and minimal bipolar current, which would dry the nerve to a yellowish, moderately coagulated appearance over an area one-half inch long was used, and the nerve was severed at the middle of this region. Postoperatively these patients had more discomfort than is usually noted after treatment of nerves with absolute alcohol, or severing them without alcohol injection. This consisted of drawing sensations referred to the muscles of the leg, ankle, foot and toes. This usually started two or three days after operation, reached its maximum in three or four days more, and gradually subsided until there was practically no annoying sensation after the elapse of a month to six weeks. None of these patients continued to complain of pain after this time. They seemed unusually confortable. The time of observation varied from three to six months.

An effort was made to obtain experimental information by desiccating and dividing a large nerve in the hind leg of each of two rabbits, and severing the same nerve in another rabbit with a scalpel. After six weeks the operative site was in-

spected. In two cases there was a diffuse, or ribbon, fan-shaped, out-growth of the nerve and about one-half inch long. In the third rabbit, the nerve had been severed with a scalpel without desiccation. Here there was a small bulbous area with a cord-shaped out-growth from the tip about one-fourth inch long.

These specimens were studied by a pathologist but, unfortunately, the report and specimens apparently have been lost, due to confusion incident to closing our office.

While the experimental and clinical background for this work have been inadequate and inconclusive, the clinical results were promising enough to suggest that it be given further trial. Inasmuch as there will certainly be many painful amputation stumps resulting from the war, anything which carries any possibility of lessening this number deserves further study. The advantage of this method seems due to the uniform dessication of the nerve, no matter how small. So often alcohol cannot be successfully injected because the nerve consists of several bundles without a firm outside sheath to cause the alcohol to diffuse evenly and remain in contact with the nerve fibers. It is hoped that neuromas do not form when this method is used.

THE ligaments on all sides of the knee are so strong that complete dislocation is rare. Partial displacement or subluxation may accompany severe sprains. When dislocation does occur it is produced by extreme force applied anteriorly or posteriorly, which tears the crucial, lateral and capsular ligaments.

From "Fractures and Dislocations for Practitioners," by Edwin O. Geckeler (The Williams & Wilkins Company).

# TREATMENT OF THE FRACTURED FEMUR IN CHILDREN*

LEONARD F. BUSH, M.D.†
Diplomate of the American Board of Surgery
DANVILLE, PENNSYLVANIA

AGE plays an important part in arriving at a decision as to the best type of treatment to be used in fractures of various bones of the body. In treatment of fractures of the femur in children this is particularly true. Several methods are in use, a number of which produce excellent results in the hands of surgeons skilled in their use.

Of the older methods, the Hodgen and the Thomas splint are especially to be noted. These splints may be used in conjunction with overhead or direct traction. With the Thomas splint, countertraction may be carried out by elevation of the foot of the bed. The Bryant vertical traction and the Russell traction seem to be the most popular methods used at the present time. Russell traction is an excellent form of treatment for children and adults alike. It is particularly adaptable to children six to twelve years of age. Bryant's vertical traction, utilizing the weight of the trunk as countertraction, is very popular, especially with children up to five or six years of age. The plaster spica has been used for many years by surgeons, with varying degrees of success. The spica is necessarily used following open reduction and plating.

There are certain disadvantages in treatment of fractures of the femur in children by traction. First, considerable mobility of the fragments will occur especially when used on an active child. Although good alignment may be maintained, proper apposition of the fragments is often difficult. Skin traction may result in various complications if maintained for any length of time. Skeletal traction may be used, especially in the Russell method.

Despite the fact that firm union usually occurs in children even when there is overriding or complete displacement of the ends of the fragments, there are certain procedures which will aid in producing quicker and better end results in the treatment of these fractures. The criteria of a good ultimate end result are firm union, normal alignment, and normal length. To obtain them, complete immobilization is necessary and is readily achieved by a properly applied plaster spica.

Those who have condemned the spica have done so on the grounds that there is a tendency to overriding with angulation of the fragments. In our hands the plaster spica has given unusually good end results.

Use of the spica has definite advantages. It is easily applied, giving proper immobilization following reduction, and it maintains normal bone length. The period of hospitalization is greatly shortened, usually being but one or two days, an important factor in a busy general hospital where rapid turn-over of patients is essential. With the child in a cast, nursing care is greatly simplified. The period of plaster immobilization is usually three to four weeks. The spica is especially adaptable in infants and children up to ten to twelve years of age and whether the fracture be transverse, oblique or comminuted.

Open reduction is never resorted to until all conservative measures have been exhausted and satisfactory reduction not obtained. Arguments against plating are: union is delayed; there is the danger of infection and trauma to the soft parts; the period of treatment is prolonged, particularly if the plate is removed later. When open reduction does become neces-

* From the Department of Surgery, Geisinger Memorial Hospital.
† Dr. Bush is now a Major on active duty.

sary we believe the plate should invaribly be removed as soon as firm union has taken place.

for children. It provides quick and complete anesthesia, is safe, there is minimal nausea and vomiting and the patient recovers rapidly. Vinethene is irritating to mucous membranes and, therefore, should not be used in the presence of active respiratory infections. Occasionally, the fluoroscope will greatly facilitate the reduction.

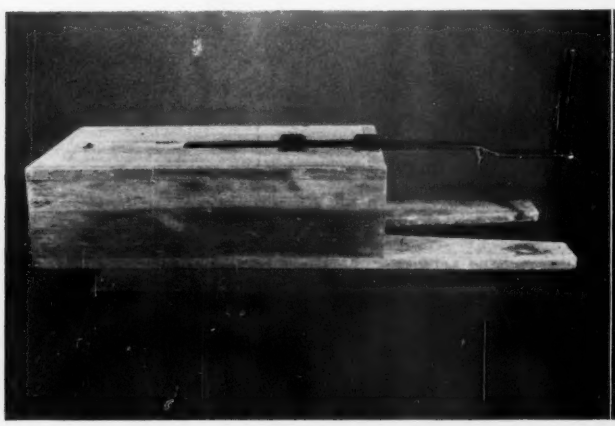

FIG. 1.

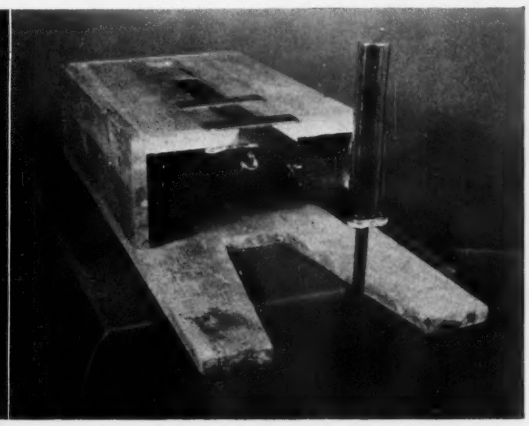

FIG. 2.

FIGS. 1 AND 2. These pictures illustrate a simple adjustable fracture box which may be clamped onto any table.

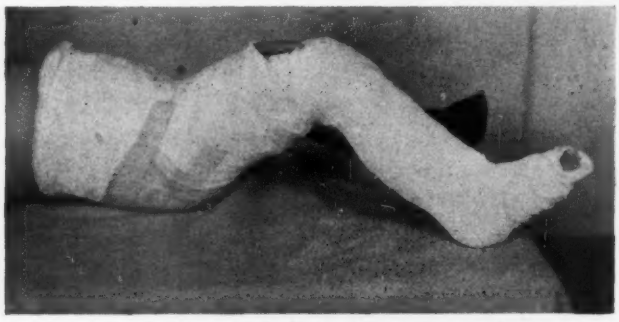

FIG. 3. Lateral view of spica showing angles of flexion used at hip and knee.

Displacement of the short upper fragment by muscle pull in fractures of the upper one-third of the femur often necessitates open reduction. Compound fractures frequently call for plating. Wounds associated with compound fractures are thoroughly débrided and treated with free applications of sulfanilamide. Where small puncture wounds result from compound fractures, they may be properly cared for, the fracture reduced and if the problem is simple a plaster spica applied.

To manipulate and properly reduce a fracture, complete relaxation of the patient is necessary. Ether is probably the best general anesthetic for this purpose. It may be administered by the open drop method or in conjunction with one of the gases. Vinethene is an excellent anesthetic

The spica may be applied by placing the patient on a simple fracture box (Figs. 1 and 2) or on any of the modern fracture tables.

## APPLICATION OF SPICA

Under deep anesthesia and with countertraction at the perineal post of the fracture box or table the spica is applied. The bony prominences (anterior superior spines of the ileum, and sacrum especially) are padded. The leg is manipulated while traction is maintained on the opposite limb. The traction upon the fractured femur is

maintained with the thigh flexed 15 to 25 degrees at the hip and the knee flexed at right angles. A tight cylinder of plaster is then applied around the fractured thigh. While it is drying the body and opposite leg are encased and both groins are reinforced with plaster strips. A cross bar (thigh to thigh) is incorporated to add strength to the cast and to aid in the after care and handling of the patient. The knee and lower leg are then encased in a thinly padded cast, constant traction being maintained at the knee throughout the procedure and until the cast is dry. With the double spica on the thighs and the knee at right angles the normal bone length and alignment are maintained.

Fig. 4. Anterior view of cast immobilizing fractured right femur.

By flexing the thigh at the proper angle and the knee kept at right angles, the muscles are in a position of relaxation. Bed care is then as simple as with any other type of cast. Patients treated in this manner have been uniformally comfortable throughout the period of three to four weeks of immobilization. (Figs. 3 and 4.)

During the past six years we have treated thirty-nine fractured femurs in children. The patients have ranged in age from three months to thirteen years. There were three deaths, all occurring shortly after admission to the hospital and due to extensive injuries. With seven patients an open reduction and plating was necessary. But two such procedures have been necessary in the past five years since we have utilized the described cast. In both instances the fractures involved the upper one-third of the femur.

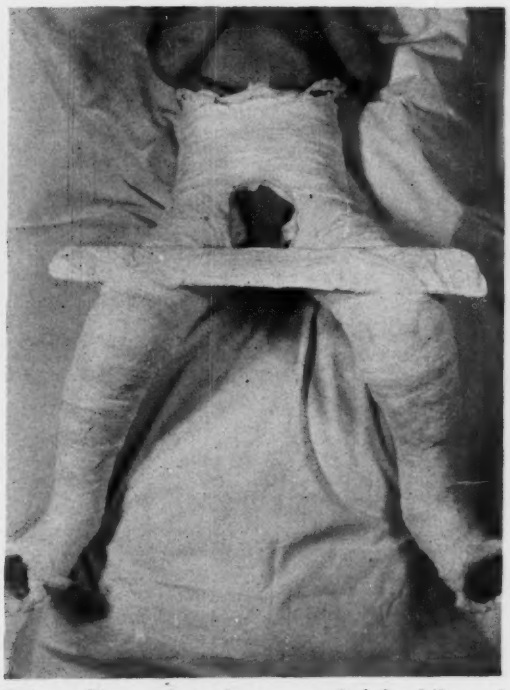

Fig. 5. Shows the spica as applied for bilateral fractures of the middle third of the femur.

Twenty patients were treated by immediate reduction and application of the spica. Ten were treated by temporary traction (while shock and other conditions were cared for) followed by application of the cast.

Two patients were treated in the dispensary, without being hospitalized. As a general rule, it is advisable to observe the patient in the cast for at least twenty-four hours, in the meantime having the necessary *x*-ray examinations made before discharging the patient from the hospital.

On the average, children treated by spica alone in our clinic were bearing weight by the fifth to the seventh week.

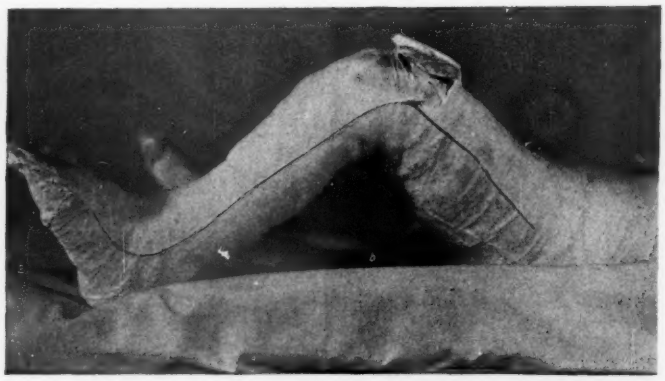

FIG. 6. Lateral view of cast utilized in fracture of both femurs.

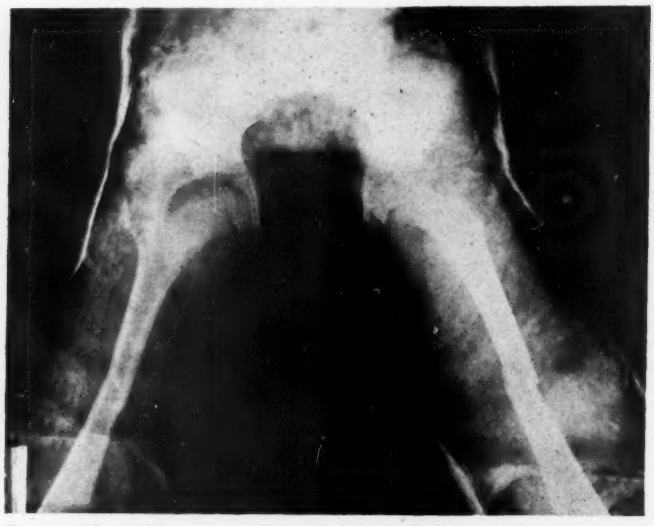

FIG. 7. *X*-ray illustrates the position and alignment as obtained by the cast in bilateral fractured femurs.

The casts were usually removed by the end of the fourth week.

Those fractures requiring plating naturally rendered a longer period of disability, particularly was this so when the plate was removed.

The end results with the thirty-six patients so treated, as judged from follow-up studies, were excellent for the entire group.

The treatment of bilateral fractures of the femur is illustrated in Figures 5, 6 and 7.

## CONCLUSIONS

1. A simple method has been described for the care of fractured femurs in children.

2. The advantages of the method over other forms of traction are: (1) shorter period of hospitalization; (2) ease of care of the patient; (3) it may be used in infants or children up to ten or twelve years of age; (4) there is no pressure, infection or necrosis of tissue as occasionally occurs with continued skin or other forms of traction; (5) the child is comfortably immobilized, and (6) universally good results have been obtained as evidenced by early union, normal alignment and bone length and, finally good function.

# CASTILIAN MALVA

CAPTAIN M. MARKS
MEDICAL CORPS, ARMY OF THE UNITED STATES

WHILE investigating plants used in folklore medicine, Thomas[1] became especially interested in the therapeutic and pharmacological action of a weed commonly found in the southwestern part of the United States. It is a low growing shrub of the mallow family and is known as Malva parviflora L., also called "running mallow." The bruised leaves and bark have long been used to heal a large variety of wounds. Thomas found that an alcoholic infusion of the whole plant, at low temperature, extracted a stable resin which produced rapid vascular dilation and an increase in the healing rate of injured tissue to which it was applied. His work dealt with the action of the resin in infectious, necrotic, and gangrenous lesions; and except in certain cases with vascular impairment, his results were uniformly good.

The purpose of this study* is to investigate further the properties of this plant extract, particularly in the field of proctology where surgical wounds are constantly bathed with pathogenic organisms that frequently protract the healing period.

| Types of Wounds Treated | No. of Cases |
|---|---|
| Pilonidal sinuses, open type of operation | 25 |
| Abdominoperineal resection | 7 |
| Abdominal wound rupture | 4 |
| Pruritis ani | 56 |
| Hemorrhoids—postoperative | 125 |
| Fistula-in-ano—postoperative | 18 |
| Pyodermia | 2 |
| Perianal psoriasis | 3 |
| Rectal abscess | 15 |
| Potanal fissure | 28 |
| Post-proctotomy for anal stricture | 6 |
| Perianal chemical burns | 12 |
| Total | 303 |

## CLINICAL OBSERVATIONS

The prepared tincture in the dilution suggested by Thomas of 1:50 was first employed by irrigation and wet packs. On a freshly denuded surface its use results in marked increase in capillary bleeding. There is also a sensation of warmth and frequently smarting that persists for several minutes. The broken surface slowly becomes diffused with a deeper redness that includes the margins of the wound.

In older lesions an excess of transudate appears; droplets of serum exude which prove microscopically to contain many phagocytes and much tissue débris. Liquefaction of necrotic material is grossly evident at the end of the first hour, at which time the maximum effect of the medication is reached. Within twelve hours the raw surface appears roughened and under a hand lens tufts of rapidly proliferating granulation tissue are visible. When the solution is stopped the hyperemia slowly subsides. At the same time the lymphogogue action and the cellular activity become proportionately less. In none of the cases was there evidence of local or systemic toxicity. The only adverse finding was a sensation of burning experienced by hypersensitive individuals. In these a weaker concentration such as 1:100 could be well tolerated. In others, solutions with a dilution as high as 1:25 produced no ill effects even following constant application for days.

Castilian malva solution produces the described physiological response in wounds having a neutral or slightly alkaline content. When the hydrogen ion concentration falls below 6.2 the resin becomes inert. Thomas discovered that fermentation and the resultant acidulation in aqueous infusions of the plant rendered the resin useless. To study this further I used Castilian malva to irrigate superpubic and other wound of the urinary tract. No therapeutic response was seen until the urine was alkalinized. Two cases of proved peptic

* The material for study has been supplied by Upjohn and Company.

ulcer were also treated by incorporating 2 per cent of the tincture in a bland, neutral syrup. Two teaspoonsful were taken before meals and although well tolerated at the end of two weeks there were no appreciable changes in the subjective symptoms or in the *x*-ray findings.

To facilitate the application of the medication Thomas suggested the use of a jelly as a vehicle. By incorporating the tincture in a neutral, water-soluble base in the concentration of 2 per cent, I obtained a still more practical method of utilization which facilitated dressings in ambulant patients and also permitted more constant contact of the medicament in cavities.

Healing was more rapid in deep wounds such as follow perineal resection, pilonidal sinuses, evisceration with delayed healing of the abdominal wall, postoperative fistula, posterior proctotomy, and incised perirectal or pelvirectal abscesses. These, once good drainage was established and under the stimulation of the resin, rapidly became clean, lost their offensive odor, filled with firm healthy granulation tissue and healed with soft pliable scar. This accelerated healing was further demonstrated on superficially injured skin as in burns and in pruritis ani. In these chemical, thermal, or onychial trauma along with the irritation of the stool may be severely annoying. By its vasodilating action the quantity of circulating blood is markedly increased in the injured parts. Re-epithelization and softening of the inelastic, acanthotic, and macerated skin are noticeable within twenty-four hours and as healing progresses the itching becomes less. In the postoperative care of anorectal wounds the ointment may be applied with the gloved finger or by means of the pile pipe. In the open type of hemorrhoid operation the average healing period is from fifteen to twenty-one days. With the use of Castilian malva convalescence is reduced to ten to fifteen days. Since healing is more rapid, pain and tenesmus is greatly diminished and the resultant scars are softer with less tendency to latent fissuring. The presence of bacteria in no way alters the action of the medication. As the drainage from these wounds increases it becomes less irritating. The number of organisms are reduced apparently due to the increased volume of the lymph and the greater number of phagocytes present.

## COMMENT

Wound healing depends primarily upon the rate of growth of new blood vessels, lymph channels, and fibrous tissue. Since Castilian malva has neither bacteriocidal nor bacteriostatic action, its effect must be due to stimulation or acceleration of the normal process of tissue repair. The histamine-like, vasodilating action of the resin in solution or in ointment form increases the permeability of the capillaries, seemingly decreasing the tension in the walls of the vascular bed by weakening the intracellular cohesion. This is assumed to take place since the lymphogogue action also increases the diapedesis of phagocytes. When this condition is created maximum cellular regeneration takes place.

Castilian malva is applicable only as an adjuvant to promote and stimulate healing in cavities and superficial lesions. It cannot be considered a substitute for proper surgical care.

The discovery of a large quantity of betaine, a trimethyl glycocoll in the plant extract lead to the possibility of it being the active principle of Castilian malva.

Thirty-five gr. of betaine hydrochloride dissolved in 1 gallon of alcohol was used as a 2 per cent solution in the same manner as the resinous tincture. In sixty cases of infected, non-infected and necrotic wounds of the extremities this substance gave no evidence of therapeutic value.

## CONCLUSIONS

The tincture of Castilian malva is nontoxic when applied to a wound or when ingested.

It is inert in the presence of a hydrogen ion concentration below 6.2.

It has no bacteriostatic nor bacteriocidal effect.

Its physiological effect seems to be due to its vasodilating action.

Its use increases the rate of normal physiological tissue repair.

Incorporation of the tincture in a water-soluble base facilitates its use. These findings confirm those of Thomas.

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*The larynx which has healed after tuberculous involvement cannot be considered cured; it may be considered healed, arrested, latent or apparently cured.* The disease in every tuberculous larynx which has healed can become reactivated. With very few exceptions, the healed larynx indicates that the lung is also healed.

From "Tuberculosis of the Ear, Nose, and Throat," by Mervin C. Myerson (Charles C. Thomas).

# ESSENTIAL HYPERTENSION

## SURGICAL TREATMENT

WILLIAM P. E. BERWALD, M.D. AND KENNETH D. DEVINE, M.D.
Senior Neurologic Surgeon, Highland Hospital, ROCHESTER, NEW YORK
Fellow in Surgery, Mayo Clinic, ROCHESTER, MINNESOTA

IN the past three years we have treated twenty-nine patients by extensive sympathectomy for essential hypertension. Twenty-four of these patients were operated using Adson's subdiaphragmatic approach, four were operated upon using Smithwick's dorsolumbar approach, and the remaining patient had the Smithwick operation on the right side and the Adson operation on the left side. All of these patients were carefully selected preoperatively and range in age from twenty-one to fifty-eight years. Kidney biopsies were taken from fourteen patients. All but two patients are living at the present time, and it has been possible to make a careful follow-up on each of the surviving patients.

While the surgical attack on hypertension is only slightly more than twelve years old, it is rapidly gaining in popularity. There is still a group of clinicians whom we might call "perfectionists," and nothing short of complete and permanent cure would satisfy them. The surgeon realizes that except in the most ideal cases, he cannot cure hypertension, but he can effect partial cure, temporary alleviation and great subjective improvement in a large percentage of properly selected cases. We believe that there is vastly more to the problem of hypertension than the manometric blood pressure reading, and it is unfair to judge the value of any therapeutic measure solely by this criterion.

Both the subdiaphragmatic and dorsolumbar operations are performed through a lumbar hockey-stick incision. The subdiaphragmatic operation requires a subperiosteal resection of about one and one-half inches of the twelfth rib and consists of removing the first, second, and sometimes the third lumbar ganglia with the intervening trunk and section of the greater splanchnic nerve as it passes through the crus of the diaphragm, following it in to the corresponding celiac ganglion, and removing two-thirds of the latter. The dorsolumbar operation requires the removal of practically the entire twelfth rib and splitting of the diaphragm; and it consists of removal of the sympathetic chain from approximately the eighth thoracic ganglion through the first lumbar, and the manual avulsion of the greater splanchnic nerve almost as high as the midthoracic region and removing it just as it enters the celiac ganglion. The dorsolumbar operation is obviously the more difficult and dangerous and is attended by a pneumothorax in better than 33 per cent of cases. The pneumothorax can be relieved, however, at the conclusion of the operation by aspiration of air through a soft rubber catheter from the intrapleural space, after which positive pressure is exerted by the anesthetist through the gas machine to reinflate the lung. The mortality rate of the subdiaphragmatic operation is nil, whereas with the dorsolumbar operation it is about 3 per cent. Either type of operation is performed first on the right side and then on the left side, a week to ten days apart.

The rationale for sympathectomy in the relief of essential hypertension is predicated on the following results of the denervation: (1) Relaxation of a large portion of the vascular bed, i.e., the blood vessels of the lower extremities and the splanchnic bed; (2) the postural fall in blood pressure which always follows sympathectomy but usually disappears over a period of months or a few years; (3) increased blood supply to the

kidneys, and (4) a decrease in the amount of adrenalin secreted as a result of excitement, fear and other vasomotor stimuli.

The first two results mentioned are irrefutable. The last two are still open to discussion, although there is a growing body of evidence to support them.

Our criteria for operation are in brief: Age, fifty or under. Here again we are more interested in physiologic age than chronologic age, as obviously it would be unwise to deny a patient of fifty-two with elastic arteries the benefits of the operation. We refuse operation to patients who fail to respond in any measure at all to the sodium amytal and sodium nitrite tests.

The sodium nitrite test consists of giving the patient ½ gr. of the drug every half hour for six doses, and recording the blood pressure every half hour for five hours. In the meantime, the room is darkened, visitors are barred, and nursing care is restricted to absolute essentials. The sodium amytal test follows the same pattern except that 3 gr. of the drug are given every hour for three doses.

In reviewing the results of these tests on our first twenty-nine patients, we have been able to deduct some general statements about their value in determining the approximate final results one might expect in any given candidate or group of candidates for extensive sympathectomy. When under the influence of sodium nitrite the diastolic blood pressure is reduced 20 mm. of mercury or more, the chances are that 64 per cent will have a good final result. When under the influence of sodium amytal the diastolic blood pressure is reduced 20 mm. of mercury or more, the chances are that 60 per cent will have a good final result. The lowering of the systolic blood pressure by these two drugs is a less accurate criterion of the eventual result.

Patients with advanced cardiac and renal damage are refused the operation. The fact that a patient has had a cerebral accident should not bar him from the benefits of sympathectomy, provided that he has made a satisfactory recovery. As a rule, we refuse operation to very obese individuals and insist that they lose considerable weight before we will reconsider them for surgery. We have not been particularly impressed with the relationship between retinal vessel sclerosis and response to sympathectomy in our series of cases.

Our operative results have been on the whole impressive. Of the twenty-nine patients, two are dead. One died of coronary thrombosis one and one-half years following operation, and the other died as his wound was being closed following a second stage dorsolumbar sympathectomy. This is our only operative death. Postmortem examination of this patient revealed tremendous cardiac hypertrophy and bilateral pulmonary collapse. In reviewing our case histories, we found that the average preoperative blood pressure was 244/127, and the average postoperative blood pressure taken on an average of 9.8 months following sympathectomy was 166/112. The average reduction in systolic pressure was 78 mm., and the average diastolic reduction was 15 mm. The average systolic drop under sodium nitrite and sodium amytal was 42.7 mm., and the average diastolic drop was 18.2 mm. Comparison of these figures reveals that sympathectomy can better the results of sedative and vasodilating drugs in so far as the systolic reading is concerned, but falls slightly short of their effect as regards the diastolic value. This deduction is predicated on the administration of rather large doses of each drug, i.e., 9 gr. of sodium amytal and 3 gr. of sodium nitrite within separate three-hour periods. These doses would obviously be rather disastrous clinically.

We consider it to be a good result when the drop in systolic blood pressure is 50 mm. of mercury or more, and the drop in the diastolic blood pressure is 20 mm. of mercury or more. Objectively, there has been a good response in eighteen patients, and a poor response in ten. Translated into percentages, we were able to effect objec-

tive improvement in 64 per cent of patients. The average length of known duration of hypertension was 4.9 years. The longest duration was nineteen years, and the shortest was six months. We found no evidence of any relationship between the length of known duration of hypertension and the end results of sympathectomy.

Of the twenty-nine cases, biopsies of the left kidney were taken from fourteen patients. Smithwick has shown previously that biopsies taken from both right and left kidneys in the same patient are essentially similar in so far as pathologic changes are concerned. All of our fourteen biopsies showed pathologic changes, although a few were very mild. The changes were obliterative glomerulosclerosis, with or without interstitial nephritis. One specimen showed tubular nephritis without renal vascular change. Of five patients whose urines were negative as to albumin and the microscopic examination, who concentrated their urine well, and who had normal non protein nitrogens, two showed glomerulosclerosis, one showed tubulonephritis, and the remaining two showed early arterial obliterative changes. It would appear from this that our present common tests for renal disease are not very accurate criteria. Of the fourteen patients from whom biopsies were taken, ten showed good results following sympathectomy. Smithwick has shown recently that of one hundred biopsies taken from patients during the course of sympathectomy for hypertension, 28 per cent showed insignificant or no vascular disease, and in more than one-half the cases the morphologic evidence of renal vascular disease was inadequate to be considered the sole factor in producing the hypertension. He concluded, therefore, that the hypertensive state antedated the renal vascular lesion. As regards the improvement in kidney function following sympathectomy, several of our patients who before operation had albuminuria now have urines which are albumin free.

So far we have been talking about objective results only; the subjective results are more dramatic. Questionnaires were sent out to the twenty-seven surviving patients. They were given a choice of checking "greatly improved," "moderately improved," "slightly improved," or "not improved," and were specifically requested not to sign their names. All questionnaires were returned and the results were: fifteen greatly improved, nine moderately improved, one slightly improved, and two not improved. Translated into percentages, over 92.5 per cent of patients felt subjectively improved as a result of their sympathectomies. One patient was so enthused about her subjective improvement that she wanted me to advertise the operation over the radio.

## CONCLUSIONS

We who are operating for the arrest and relief of essential hypertension are, I believe, justifiably enthusiastic about our results. When one considers that the vast majority of patients who seek our aid are referred by clinicians who have already exhausted the medical armamentarium in attempting to relieve them, and we are then able to effect objective improvement in 64 per cent and subjective improvement in over 92 per cent of these cases, it would appear that sympathectomy has a real value, and is here to stay, at least until a better method or methods are discovered. We have occasionally heard the criticism that the operations are too dangerous and strenuous for the patient compared to the relief obtained. Nothing could be further from the truth. There are few operations which are attended by as little risk and postoperative discomfort as extensive sympathectomy, and the relief obtained, as we have shown, speaks for itself.

# SIMULTANEOUS PERFORMANCE OF RUBIN TEST AND ENDOMETRIAL BIOPSY

SAMUEL S. ROSENFELD, M.D.
Attending Obstetrician, Jewish Memorial Hospital
NEW YORK, NEW YORK

THE Rubin insufflation test has proved itself invaluable in gynecological diagnosis and therapy. The endometrial biopsy is of undoubted diagnostic and prognostic aid. The writer has for some time been employing a technic which simultaneously combines both of the above mentioned procedures.

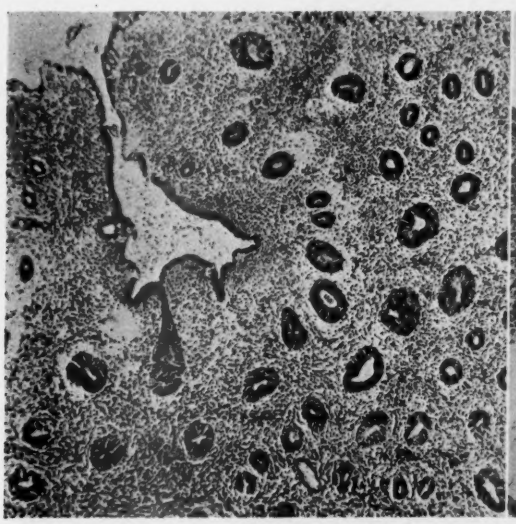

FIG. 1. Endometrium; follicular phase; specimen obtained by suction curette.

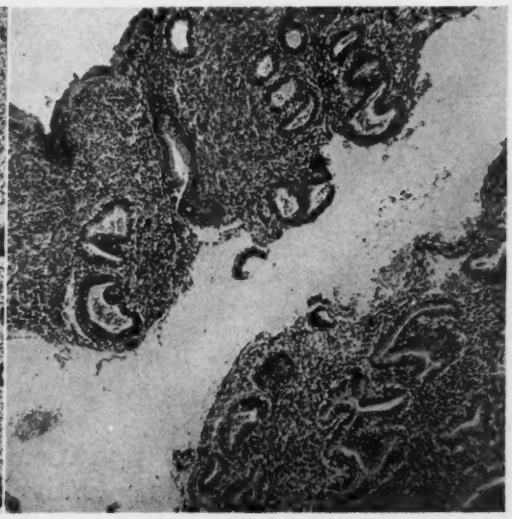

FIG. 2. Endometrium; lutein phase; specimen obtained by intra-uterine cannula.

*Technic.* The patient is prepared as is customary for the performance of the Rubin test. The gas (*carbon dioxide*) is passed through a standard uterine cannula. After the desired quantity of gas has been introduced, a syringe is attached to the distal end of the cannula, and suction is created by pulling the plunger. The cannula is then removed and immediately placed in a jar containing a solution of 10 per cent formalin. Small pieces of tissue are practically always seen adhering to the surface of the cannula and these fragments float off and fall to the bottom of the jar. A syringe is then attached to the distal end of the cannula and the formalin solution is alternately drawn up and expelled, thus washing out any small pieces of tissue which might be present inside the cannula.

This method has yielded satisfactory sections in the majority of cases. Occasionally, only very small fragments could be obtained by this technic. I find that adequate and excellent sections can always be obtained by using a standard suction curette.

To avoid the possibility of gas embolism and the dissemination of endometrial fragments the sequence should always be first insufflation, followed by suction curettage.

# Case Reports

## COMPLICATED DIVERTICULITIS OF SIGMOID*

### CASE REPORT

L. Albert Thunig, M.D.
Attending Surgeon, St. John's Hospital
BROOKLYN, NEW YORK

MOST of us learn and profit more from our mistakes than from our brilliant successes. Brilliant successes in surgery frequently are published; mistakes, however, are rarely published, so that, as a general rule, we profit only by our own mistakes with only an occasional opportunity to learn and profit by the mistakes of others. It is because of these facts that I report this case which most assuredly presents an error in diagnosis and an error in gross pathological interpretation at operation with consequent unindicated operative procedure.

The case to be presented was unquestionably an unusual one of old perforated and ulcerated diverticula of the sigmoid, diffuse left lower abdominal peritonitis, with an additional old sealed pyosalpinx and para-ovarian cyst on the left side. The history, symptoms and physical findings were misleading and lead to a diagnosis considerably in error. At operation the lesion of the sigmoid was interpreted as a perforating carcinoma of the sigmoid; the sigmoid was resected and a high left permanent single barrel colostomy instituted. Pathological examination of the specimen revealed the entire absence of carcinoma. From that moment on it became the prime objective of the operator to re-establish, if possible, the continuity of the large intestine, obliterate the colostomy and establish bowel evacuation per anus. The patient had many serious complications and underwent three additional major and one minor operative procedure, but at the end of seven months the objective was achieved and the patient was discharged from the hospital as cured with a continual and progressive improvement in her general health and intestinal function.

### CASE REPORT

Mrs. J. M., a widow, age forty-eight years, was admitted to St. John's Hospital August 7, 1941, and discharged March 7, 1942.

Important facts in her past history were: Appendix and right ovarian cyst removed fourteen years previously; last menstrual period in December 1940, no bleeding since. In March, 1941, she had an attack of upper abdominal pain with distention, nausea and vomiting. She was examined by a private physician and told that she had an ovarian cyst.

The patient was well until two weeks before admission. At that time she developed cramp-like pains, nausea, vomiting and diarrhea. The diarrhea continued and the pain became localized in the upper abdomen. The pain was dull in character and was associated with much abdominal distention. The patient had lost twenty pounds during the past year. She had had some chills and sweats. She was seen and examined in the Out-Patient Department of St. John's and sent into the hospital with the diagnosis of ovarian cyst as large as a

* From the Surgical Division of St. John's Hospital. This case was presented before the joint open meeting of The Medical Staff of the Brooklyn Naval Hospital and The Brooklyn Surgical Society and representatives of the Medical Department of the Army, at St. John's Hospital, April 9, 1942.

cocoanut extending to above the umbilicus. A flat plate was made of the abdomen in the Out-Patient Department and was essentially

Fig. 1. *X*-ray taken August 12, 1941, after barium enema.

negative other than a moderate lumbar scoliosis.

Physical findings on admission to the hospital were: The patient was a pale woman of 119 pounds with a hemoglobin of 53 per cent, 2,900,000 red cells, 25,000 white cells with 81 per cent of polymorphonuclears. The abdomen, which was the seat of her trouble, presented a large left lower abdominal tumor which extended from the pelvis to above the level of the umbilicus; the tumor was non-tender. The abdomen was tense over the tumor site but the remainder of the abdomen was soft. Bimanual examination revealed the fact that the tumor was evidently intimately associated with the uterus which could not be definitely outlined other than as part of the mass. The tumor was firmly fixed vaginally and abdominally. Rectal examination simply confirmed the vaginal findings. The impression at this time was that the patient had a large malignant papilloma of the left ovary with adhesions and fixation.

The temperature at this time was 99°F., and the pulse 90. For two days after admission the patient had slight fever and diarrhea. On the third day in the hospital the diarrhea

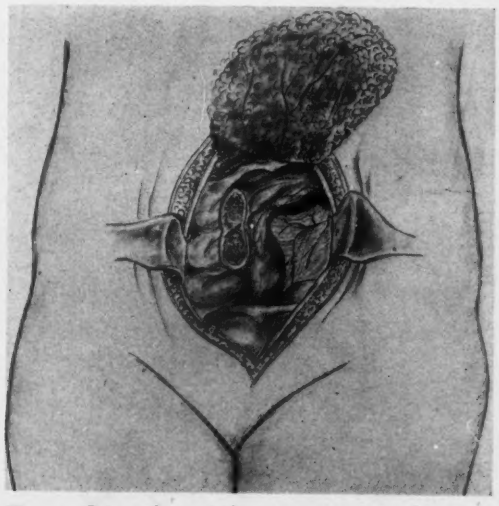

Fig. 2. Operation on August 15, 1941. Appearance of abdominal structures after thick, indurated and beaver-tail like omentum had been freed and delivered. Note the turgid enlarged sigmoid loop with the hemorrhagic and granular ulcerated areas enclosed in thick fibrous walls on its anterior and mesial aspect. Note also the thick parietal peritoneum, the high fundus of the bladder and the dome of a left-sided pelvic cyst.

subsided and the temperature became normal and remained so until after the first operation on August 15th.

On August 11, 1941, the patient was proctoscoped. A yeoman's sigmoidoscope was easily passed for the entire length without anesthesia and without discomfort. A somewhat pale rectal mucosa was evident but otherwise the examination was negative.

*X*-ray study of colon was done on August 12, 1941. (Fig. 1.) Barium was given per rectum. The report of Dr. Butera was as follows: "Rectum is normal. There is a fairly large defect in region of the junction of the sigmoid and descending colon. This may be due to spasm due to some inflammatory process, but a new growth in this area must be strongly considered. There is some colon spasm of transverse bowel."

It was now believed, in spite of the negative proctoscopy, that the patient had a definite lesion of the sigmoid associated with a large, probably malignant tumor in the pelvis. It did not seem reasonable that the sigmoid alone could account for such a huge, non-tender mass.

On August 13, 1941, 500 cc. of citrated blood was given.

The first operation was performed on August 15, 1941. (Fig. 2.) The object of the first operation was to clear out the pelvis, if possible, examine the colon and make it possible to perform the necessary intestinal surgery at a later date. That, of course, was the preoperative objective which the operator had in mind. A left paramedian incision was made from above the umbilicus to the symphysis, and the rectus muscle dislodged to the left. When the peritoneum was reached the operator immediately surmised that he was soon to have difficulties. The peritoneum with a small amount of extraperitoneal and some subperitoneal fat was the seat of an inflammatory edematous process and varied from ¼ to ½ inch in thickness. It was carefully incised and the omentum was found immediately beneath and adherent to same. The entire omentum seemed to be on the left side of the abdomen being bound down in the pelvis and adherent to the fundus of the uterus superiorly and posteriorly and to a mass beneath, which corresponded to the location of the sigmoid. The left and right edges of the omentum were moderately free. The right lower abdomen and upper abdomen were now walled off with pads. The omentum was then separated by blunt dissection and during this process two pockets of frank yellow pus were entered, one at the right fairly high up and one in the lower left pelvic area. This pus cultured hemolytic streptococcus predominating, with Bacillus coli and Bacillus subtilis. The pus was aspirated and the areas sponged dry. No well defined pockets were demonstrable during the operation. The omentum was now delivered out of the abdomen. It presented a very extensive inflammatory reaction being markedly contracted, about one inch in thickness, firm and edematous and looked like a miniature beaver's tail.

The left lower abdomen presented the following: Numerous adhesions throughout, a tense, rigid sigmoid loop with extensive fixation and bound down to the uterus. On the anterior mesial aspect of the sigmoid at about the middle of the loop there were two open areas adjacent to one another with thick glistening walls and filled with a granular, grumous, red material which certainly looked like ulcerated carcinoma. The top of the fundus of the uterus

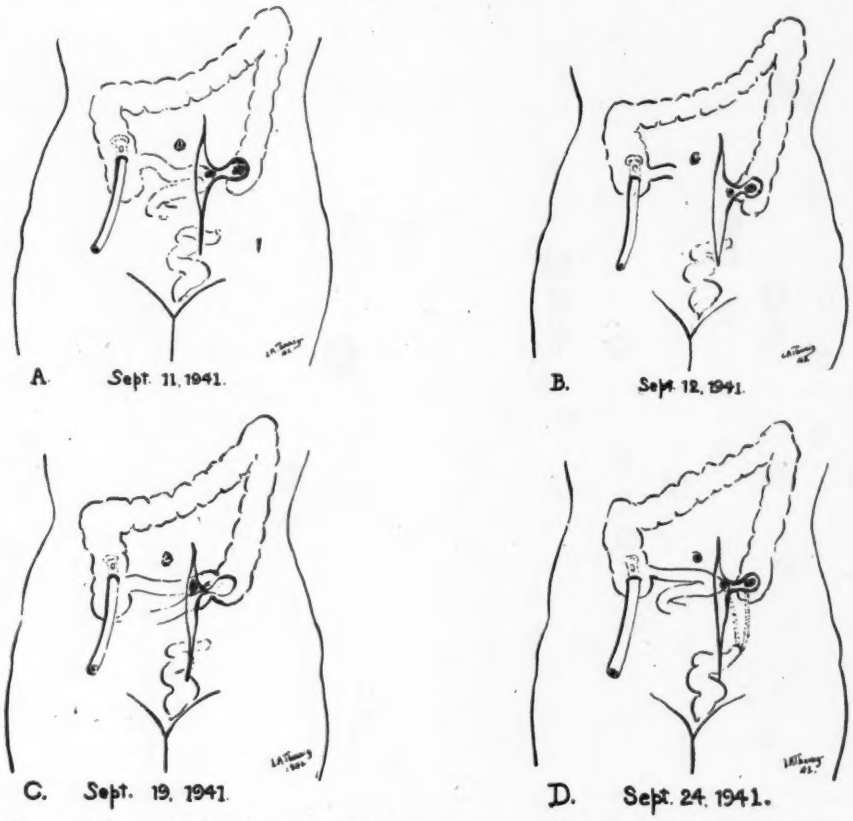


Fig. 3. Schematic drawings of our impressions regarding the openings in the intestinal tract between September 11, 1941, to September 24, 1941. These impressions are fully described in the text.

appeared normal and the dome of a left pelvic cyst was visible, the fundus of the bladder was exceptionally high but the left adnexa were not seen. For reasons which are obvious the operator made no attempt further to visualize or free the pelvic organs, nor did he dare explore the right lower abdomen, nor enter the upper abdomen to determine liver involvement and above all he dared not poke into the openings on the sigmoid to determine their destination.

Having in mind the patient's general appearance and condition, the history of the case, the *x*-ray (Fig. 1) and more particularly the appearance and feel of the sigmoid, the operator, disregarding the negative proctoscopy, felt more than reasonably certain that he was dealing with a carcinoma of the sigmoid and that the carcinoma had perforated the wall of the sigmoid. Exteriorization of the sigmoid loop would have been the best procedure but an attempt revealed the fact that the lower end of the sigmoid could not safely be brought out far enough to reach healthy intestine. Resection of the sigmoid was then decided upon and carried out from above downward. The blind end of the rectosigmoid was dropped into the pelvis and the end of the descending colon was brought out through a stab wound lateral to the original incision to form a permanent left colostomy. The original incision was closed in layers using interrupted silkworm gut in the skin. No drainage was instituted. The Payer clamp by means of which the proximal end of the descending colon had been drawn through the stab wound was allowed to remain on. Operative time was one hour and twenty minutes under spinal anaesthesia. The postoperative diagnosis was perforated carcinoma of the sigmoid, diffuse plastic and suppurative peritonitis of the left lower abdomen and pelvis and a pelvic cyst (exact origin of same undetermined.)

Immediately after the operation the operator opened the sigmoid. Much to his dismay he found the walls of the sigmoid very thick, the lumen small but no evidence of carcinoma of the inside of the sigmoid. The ulcerative lesions were entirely on the outside of the gut extending deeply into the walls of the sigmoid but actual communication with the lumen could not be demonstrated. Apparently he had been dealing with perforated, necrotic and eroded diverticula. The pathologist's diagnosis was: "Acute and chronic focal colitis and pericolitis consistent with diverticulitis."

The immediate postoperative treatment was routine intravenous glucose and saline and in addition on the afternoon of the day of operation the patient was given 3.75 Gm. of sulfathiazole in 250 cc. of distilled water intravenously.

Fig. 4. Large amount of barium remaining in blind rectosigmoid and rectum on September 22, 1941, following repeated and thorough irrigations in attempts to remove it after its injection as part of an *x*-ray study on September 19th. It had to be removed manually.

Postoperatively the patient's temperature rose to 103°F. with pulse of 150. Within sixteen hours the temperature dropped to 100°F. and pulse to 96. The patient was febrile for nine days with remissions never exceeding 100.6°F. and pulse of 120. After the ninth day the temperature was normal and the pulse 90 or less.

The condition of the wound was not so encouraging. Five days postoperatively severe wound infection was present with almost complete breaking down to the peritoneum. Fortunately, no peritonitis developed. The strip of skin between the colostomy stab wound and the left paramedian incision became completely eroded, the end of the bowel was drawn deeply into the wound but functioned exceedingly well, pouring feces directly into the large gaping wound. On August 22nd, seven days

after operation, it was noted that gas and some undigested food definitely not fecal was escaping from an opening in the wound very close to, but apparently separate from the colostomy opening. By August 24th, it was very definite that an intestinal fistula had developed in the wound. However, in spite of this the patient did well generally; there was no systemic reaction and granulation tissue developed in the wound.

With the hope that some of the fecal material might be diverted from the left abdominal wound, on September 8, 1941, twenty-five days after the first operation, the author performed a sleeve cecostomy under cyclopropane and oxygen. The function of the cecostomy with a large size Pessar catheter *in situ* varied from copious to very scant output. The cecostomy operation was followed by absolutely no general or wound reaction.

For the time being it became our objective to attempt to visualize the exact relationship of the blind rectosigmoid to the remaining large intestine and also to establish if possible the intestinal site of the additional fistulous opening in the wound on the left side of the abdomen. This additional fistulous opening was so close to the colostomy opening that it could never be definitely located in spite of many attempts to do so by means of catheters. We used various irrigations through the cecostomy and colostomy and what we presumed to be the additional fistulous opening, noted the time of return and the character of the returned fluid. The spontaneous and variable excreta of the three openings were

FIG. 5. Third operation on November 28, 1941. Condition found upon incising the peritoneum. A terminal loop of ileum traversed the middle of the operative field and its angle was densely adherent to the undersurface of the original left paramedian incision of the first operation (August 15, 1941). This was unquestionably the site of the small gut fistula as surmised in Figures 3A and D. Omentum slightly adherent to upper but distal arm of loop. Insert shows damage to ileum in its separation from old scar. The abdomen shows the colostomy and cecostomy openings as temporarily sutured on November 27, 1941. The small catheter placed in the cecostomy opening for decompression was removed prior to operation. (The adhesive plaster coverings which were present during operation are obviously not shown.)

carefully watched and grossly examined and the *x*-ray with barium was used.

The results were carefully noted on the patient's record and I shall quote them in chronological order: (Fig. 3A–D).* September 11, 1941: At this time we believed the following to be present: Cecostomy with Pessar catheter *in situ*, colostomy left, fistula from the terminal ileum near the colostomy opening and blind rectosigmoid in the pelvis. September 12, 1941: We now believed the following to be the case: Cecostomy with catheter, colostomy, no fistula from ileum, but an additional opening in the terminal descending colon near the colostomy opening and a blind rectosigmoid in the pelvis. September 19, 1941: We believed the following condition existed: Cecostomy with catheter, colostomy spontaneously closed, fistula from the ileum with an additional fistula between loop of ileum and the terminal descending colon, and blind rectosigmoid in pelvis. On this day, thirty-five days after the rectosigmoid had been carefully closed, it was deemed safe to make an *x*-ray study; barium was gently injected into the blind rectosigmoid, into the cecum and into the colostomy wound. The report was not helpful; it simply stated: Rectum patent to rectosigmoid. Barium through cecostomy outlines a short ascending colon. At this early date the author was hopeful that someday he might be able to re-establish the continuity of this large intestine, and knowing the pitfalls due to a slug of barium distal to a large intestinal anastomosis he wanted to make very certain that this rectum and rectosigmoid were empty. The rectum was carefully irrigated with only slight return of the barium injected

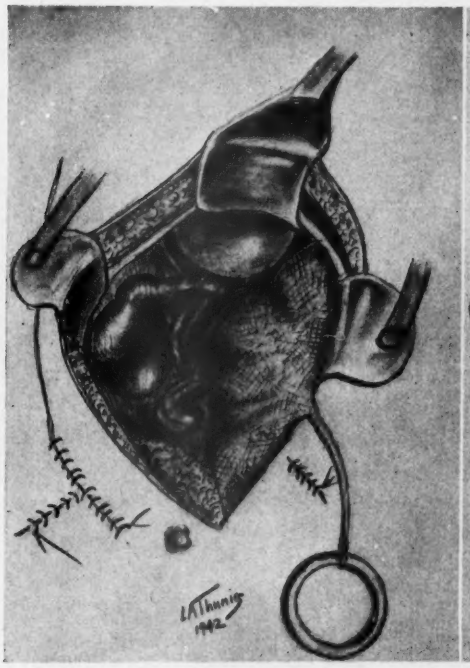

Fig. 6. Third operation, November 28, 1941; second phase. An end-to-end repair of torn ileum as shown in Figure 5 has been completed and the entire pelvic small gut has been displaced into the right side of abdomen. Many pelvic adhesions have been removed and what looked like a mass is shown to be the rectum and rectosigmoid, a blind pyosalpinx and parovarian cyst. The bladder is still unusually high almost obscuring a small uterus. The drawing presents operator's view looking down from above into the pelvis.

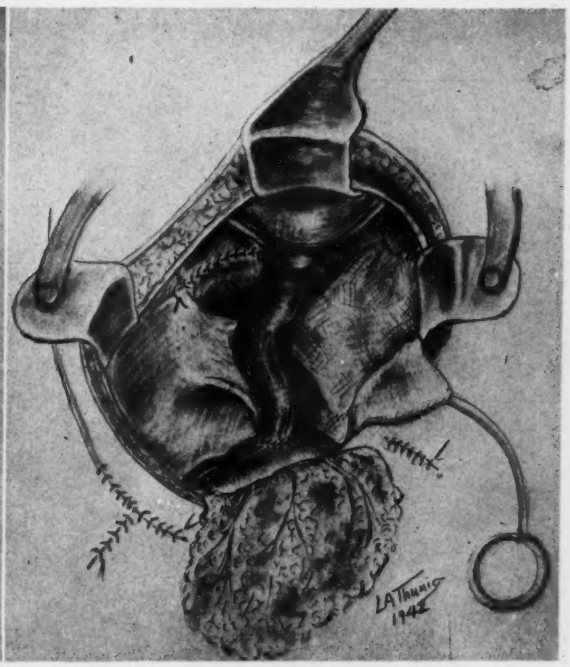

Fig. 7. Third operation, November 28, 1941; final phase. Left tube, parovarian cyst and left broad ligament (Fig. 6) have been removed and edges of base of broad ligament sutured. (The left ovary was not identified at operation nor in the laboratory; it may have been part of the large pyosalpinx and its identity lost; the author is positive that no left adnexal structures remained within the pelvis.) The rectosigmoid has been anastomosed to the transverse colon. Drawing presents operator's view looking from above downward into pelvis.

* The diagrams in Figure 3 were drawn and recorded on the patient's hospital record with the reasons for the deductions on the dates given on Figure 3.

on September 19th. After numerous irrigations an *x*-ray was made September 22, 1941, (Fig. 4) and showed a large slug of barium still present in the rectum. Irrigations were continued but failed and eventually the barium was removed by manual extraction. On September 24th, however, following a pint irrigation of the rectum by the intern, the intern reported that the irrigating fluid had gushed out of the colostomy and the cecostomy simultaneously. The intern was an excellent observer but I was inclined to doubt this observation and, accordingly, personally irrigated the rectum with a pint of methylene blue solution. The intern's observation was correct: the methylene blue appeared almost immediately in copious amounts from the cecostomy and colostomy. This was forty days after the rectosigmoid had been firmly closed.

Thus on September 24, 1941, we again changed our opinions and believed the existing conditions to be as shown in Figure 3D: Cecostomy with catheter, colostomy, fistula from terminal ileum, rectosigmoid with two tracts, one from rectosigmoid to colostomy and one from rectosigmoid to ileum. At the time the condition was noted we believed that two tracts were present and essential to produce the simultaneous expulsion from the cecum and colostomy for it seemed obvious that under no circumstances could one pint of water traverse the entire colon from colostomy to cecum or from cecum to colostomy, in the event of the tract emptying only into the ileum, in such a short space of time. A tract or tracts obviously did exist. It is quite conceivable, however, that only one tract was present and that one from the rectosigmoid to the ileum close to its fistulous opening. As has already been stated, the small fistula from the ileum opened so close to the colostomy that the two openings could not be differentiated, hence water injected into the rectum and emptying by means of a tract into the ileum could easily come out simultaneously through the fistulous opening and through the cecum by a short cut

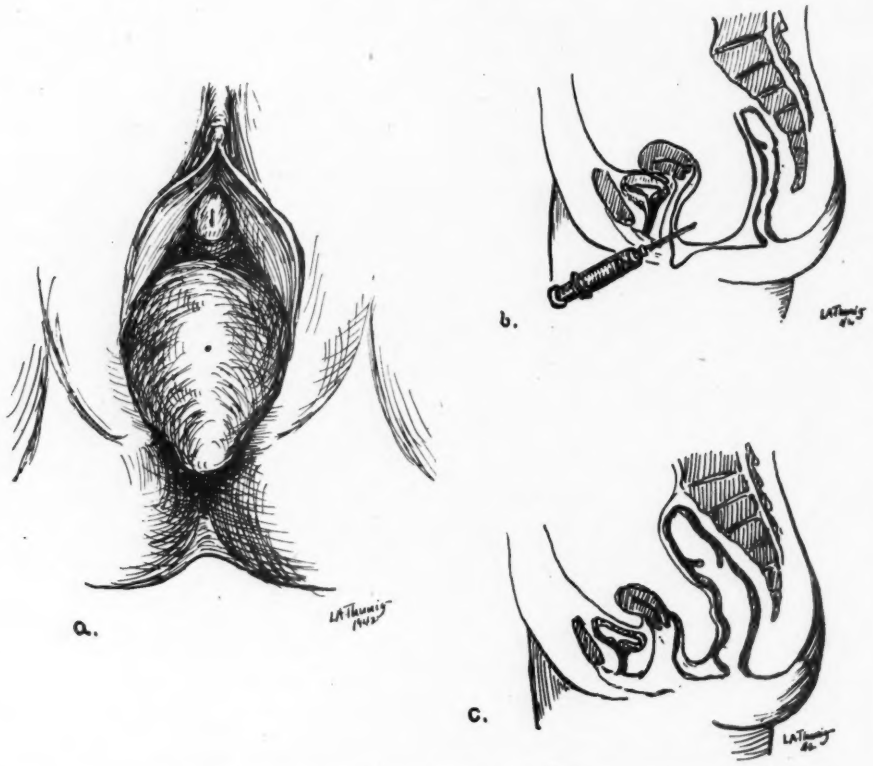


Fig. 8. a, Actual appearance of patient's perineum on December 9, 1941, eleven days after her third operation. (Figs. 5, 6 and 7.) The dot in the posterior vaginal midline represents point of aspiration. (The large fluctuating abscess could be felt between vagina and rectum with a finger in each orifice.) *b* and *c*, Diagrammatic drawings showing compression of rectum and vagina before and after the final evacuation of the abscess. The patient evidently had an unusually low cul-de-sac of Douglas.

through a short loop of distal ileum. The closeness of the fistula and the colostomy would make it impossible for the observer to be certain as to the exact point of exit. Subsequent operation on November 28, 1941, proved that impressions A and D in Figure 3 were correct as regards the small intestinal fistula being in the terminal ileum: no evidence of any existing tract between the blind rectosigmoid and the ileum and or the terminal descending colon could be found then or at a still later operation.

Generally, the patient was doing well; the colostomy and cecostomy were both functioning; the wound on the left side was clean and granulating. About the middle of October the fistula from the ileum had closed and remained closed and only typical colonic feces was being excreted. On October 17, 1941, the patient was out of bed and remained ambulatory until November 27, 1941. She had gained weight, was eating well and feeling fine. On November 11, 1941, her hemoglobin was 72 per cent, red cells 3,500,000, white cells 7,350 with 65 polymorphonuclears. On November 17, 1941, I again proctoscoped her, the rectum was empty and clean but still showed some mucosal irritation, unquestionably due to the hard dry slug of barium and the strenuous efforts to remove same. *X*-ray with the proctoscope *in situ* gave only a fair idea of the upper limit of the rectosigmoid.

On November 24, 1941, the patient was started on sulfaguanidine, 2.5 Gm., every eight hours. Cultures were made before administration and on November 27, 1941, but unfortunately through a misunderstanding colony count was not made.

On November 27th, the large intestine was thoroughly irrigated through the cecostomy and the colostomy. The colostomy and a very small area of unhealed wound were temporarily sutured over; the cecostomy was drained with a small catheter and also temporarily sutured tight about the catheter. Both openings were then closed over with adhesive plaster.

On November 28, 1941, the third operation was undertaken. The preoperative objective was to clean out the pelvis, free the rectosigmoid and establish an end-to-side anastomosis between the rectosigmoid and transverse colon. The transverse colon was chosen because it was most accessible, its circulation had not been disturbed, it was most distant from infected tissues and it would be unnecessary to disturb or possibly open up infected areas. Furthermore, an anastomosis with the transverse colon had the distinct advantage of being decompressed proximally by the cecostomy and distally by the colostony. Its great and serious disadvantage was the likelihood of establishing a permanent cesspool in the distal colon in the event of a successful anastomosis and spontaneous closure of the colostomy. The author carefully weighed all the probabilities and possibilities and still decided upon the transverse colon even though it might lead to a partial colectomy later.

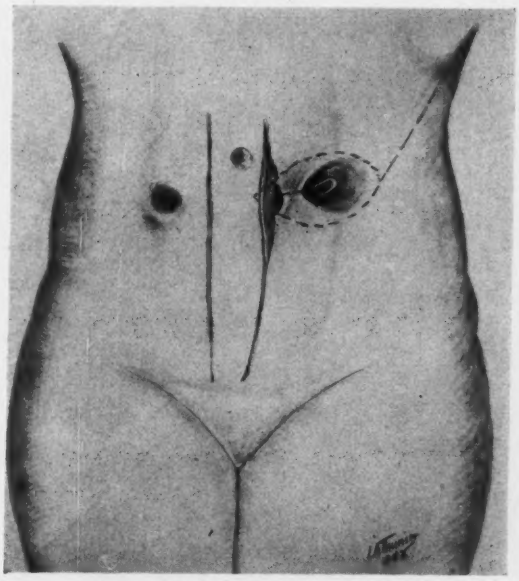

FIG. 9. Appearance of the abdomen from December 24, 1941, to February 16, 1942. The broken line represents line of incision for final operation on February 16, 1942.

Anesthesia was continuous spinal. A right paramedian incision was made. Upon opening the abdomen a loop of terminal ileum traversed the central part of the opening. (Fig. 5.) The omentum was thin and adherent to the upper but distal arm of the loop. The loop was firmly attached to the undersurface of the original left paramedian incision of the first operation (August 15, 1941); the empty bladder was unusually high. It was imperative to get the loop of ileum out of the way if the pelvis was to be explored and an anastomosis performed. This was done with the greatest of care. The omentum was gently freed from the upper but distal loop and then the angle of the loop, which unquestionably had been the site of the small intestinal fistula described in previous paragraphs, was separated. In spite of all pre-

cautions, when the loop was completely separated and delivered, it presented the appearance as shown in insert of Figure 5. The two ends were held together by the smallest strip of intestine on the mesenteric side. A two tier end-to-end anastomosis was performed and now without difficulty the entire pelvic and lower abdominal small intestine was easily placed into the right lower abdomen and held there by means of a pad. Fortunately, there was essentially no spilling from the collapsed and almost empty ileum.

A good view of the pelvis was now obtained. The uterus was very small and the vesico-uterine fold was practically obliterated by adhesions. To the left there was a mass bound up in adhesions. When the adhesions were separated and the structures freed, the mass was found to consist of the rectum and recto-sigmoid, a cyst about 7.5 by 5 by 4.5 cm. (laboratory measurements) and a tubal mass 6 by 1.5 cm. (laboratory measurements). *In situ* the structures now presented a picture as shown in Figure 6. The left broad ligament was markedly thickened. The tube, cyst and major portion of the broad ligament were removed *en masse;* this left essentially nothing in the pelvis except bladder, uterus and rectum.

Pathological diagnosis: Chronic salpingitis with pyosalpinx and para-ovarian cyst.

The rectosigmoid was now gently freed from the pelvic floor and about ½ inch of the blind end cut straight across. The transverse colon was easily brought down and an end-to-side anastomosis performed as far to the left of its middle as was possible without tension. Four Gm. of sulfanilamide were sprinkled into the abdomen and the abdomen closed tight without drainage. The operation took considerable time, two hours and twenty-five minutes. (Fig. 7.)

Fig. 10. January 7, 1942, forty days after establishment of end-to-side anastomosis; barium given per anus. This *x*-ray was made almost immediately after injection.

Fig. 11. January 7, 1942, taken a short time after Figure 10 as the intestine was emptying.

Postoperatively the reaction was extremely light; for the first three postoperative days her temperature did not exceed 100°F. with the exception of a period of four hours on the second day when it reached 101°F. Her pulse was between 110 and 120 but dropped to 90 on the second day and remained under 100 until the fifth postoperative day. On December 1st, her third postoperative day she had a small spontaneous stool per rectum, her colostomy and cecostomy had of course been opened again shortly after this operation. On December 3rd, her fifth postoperative day, her pulse rose to 120 and on December 4th her temperature rose to 100.8°F. About this time a fullness was noted in the perineal floor which was moderately

relaxed at the time of admission to the hospital. The temperature on the seventh and eighth days rose to 101.8°F. and pulse to 110. There was some very superficial wound infection but the wound did not seem sufficient to account for the rise in temperature and pulse; it was perfectly clean by the tenth postoperative day. The fullness in the perineum and especially in the posterior vaginal wall, however, increased tremendously and by December 9th, the eleventh day postoperatively presented a picture as shown in *a* in Figure 8. The tit-like projection of the posterior vaginal wall was edematous and projected out over the perineum obscuring the anus; above this it was fluctuant. A fine gauge needle and then a No. 13 gauge needle was introduced at the point marked with a dot (Fig. 8A, *a*) and 300 cc. of a thin, foul, brownish material was obtained which cultured hemolytic streptococcus, Bacillus coli, Bacillus proteus and Bacillus subtilis. No fecal particles were present. The temperature and pulse fell for a brief period of twenty-four hours, then rose again and coincidently the abscess cavity filled up again. On December 15, 1941, the fifteenth day postoperatively while preparations were being made for incision of the posterior wall the temperature was 101.8°F. and pulse 110 when suddenly the abscess ruptured through the previous aspiration hole and approximately two pints of a foul, greenish thin pus escaped; this, of course, could not be cultured. At this time the patient was and had been receiving iron and vitamin B which produced intensely black stools from the cecostomy opening (Pessar catheter had been removed December 7, 1941), from the colostomy and from the anus. Yet there was no trace of this in the abscess contents nor were any fecal particles present, hence it was a safe assumption that infection unquestionably had taken place but the anastomosis had held. The temperature and pulse immediately fell to normal after the spontaneous evacuation of the pus and remained so until February 17, 1942, the first postoperative day after her final operation. There was a slight vaginal discharge through the puncture wound for nine days but this ceased permanently on December 24, 1941, on which day the patient was allowed out of bed, and remained ambulatory until February 16, 1942.

The patient showed great improvement in her general condition. The cecostomy had spontaneously closed down to a small but still functioning vent; the right paramedian incision was completely healed; the colostomy was very

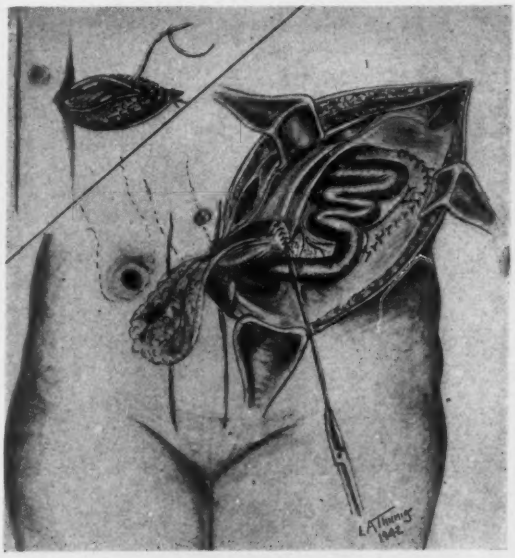

FIG. 12. The condition of the abdomen is presented after the partial colectomy has been completed and the intra-abdominal work completed. The cut rectus muscle is visible in the mesial side of the incision. The tip of the spleen and part of the greater curvature of the stomach were clearly exposed above. The open space between mesocolon and gastrocolic ligament terminating at sutured end of transverse colon are shown. The long double suture ends used to fix stump to anterior parietal peritoneum are held in hemostat. Upper end of rectosigmoid and anastomosis are pulled with slight traction into lower angle of wound. Suture line represents repaired base of left transverse mesocolon and base of cut peritoneum covering descending colon. Insert shows handling of colostomy end of incision.

small and the original left paramedian incision was healed with the exception of a small superficial area at its upper angle. A fairly wide strip of skin had again grown between the incision and the original colostomy site, but a sinus lead under this strip from the colostomy site into the superficial surface of the unhealed upper angle of the wound proper and some feces accordingly continued to contaminate this upper angle. The abdomen appeared almost the same as it did February 16, 1942, and is graphically shown in Figure 9.

On January 7, 1942, about forty days after the end-to-side anastomosis it was deemed safe to make another *x*-ray study with barium given per anus. (Figs. 10 and 11.) The *x*-ray report mentioned a Y-shaped anastomosis

between rectosigmoid and transverse colon that functions well. Figure 10 was taken immediately after the enema had been given; colonic contents to pass over the anastomosis and empty into the descending colon the author believed the following conditions prob-

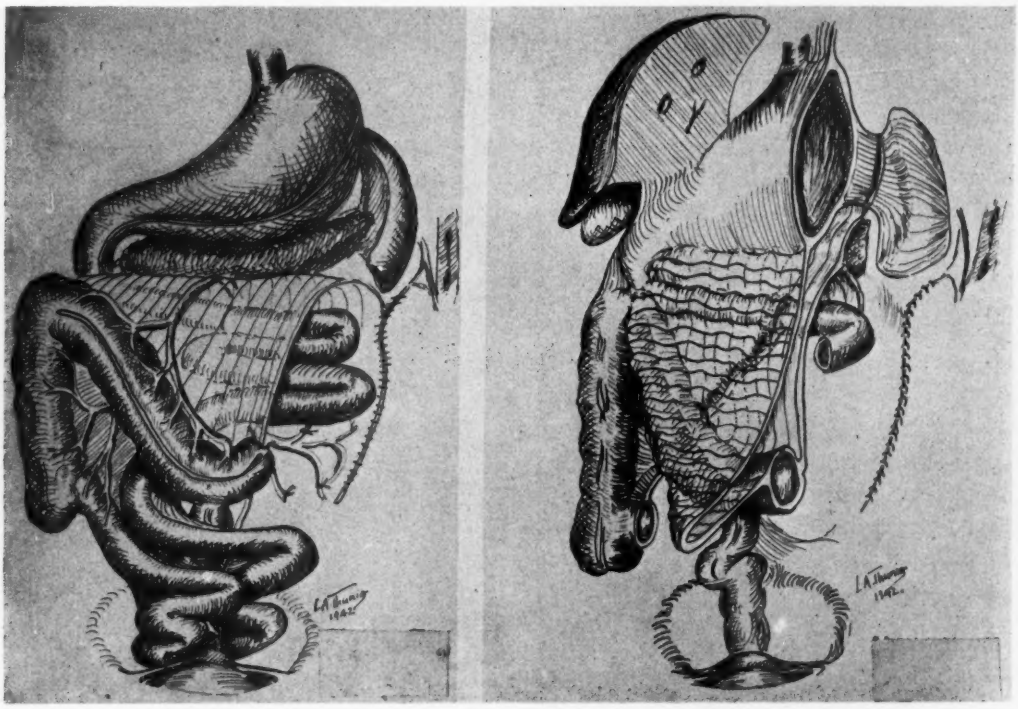

Fig. 13. Fig. 14.

Figs. 13 and 14. Diagrammatic drawings of the anatomy in this case as it was at the end of the last operation.

Figure 11 was taken after the evacuation of the barium had started. The interesting point is that in spite of the anastomosis and favorable conditions for the aid of gravity the peristalsis of the large intestine pushed a considerable part of the barium over the splenic flexure into the descending colon as is definitely shown in the *x*-ray. This fact with many others lead the author to believe that a colectomy of the transverse colon, distal to the anastomosis, the splenic flexure and descending colon to the colostomy would become necessary.

About February 9th, with a definite desire on the part of the patient to have the colostomy removed a final operation was decided upon. The condition of the abdomen was as shown in Figure 9 which also shows the line of incision for the final proposed operation. The general condition of the patient was excellent. The justifications for this final step at this time were as follows:

1. This patient insisted that she be relieved of the discomfort she had undergone for six months due to her colostomy.

2. With the tendency of a large part of the able in the event of not performing a colectomy: (1) Failure of the now very small colostomy to close spontaneously; (2) failure of even an operative attempt to close such a colostomy; (3) that should the colostomy close either spontaneously or by operation the distal transverse colon and descending colon would become a huge non-emptiable cesspool which would endanger the patient's health and life. Hence closure was definitely contraindicated. (4) If the colostomy remained open, as it probably would, and the natural function of the colon persisted in by-passing the anastomosis, the author believed that the patency of his anastomosis was threatened, that it might contract or even close, that six months of work would have been in vain and the patient would still have her colostomy. The distal and proximal decompression which seemed such consoling factors at the time of the side-to-end anastomosis might now become the undoing of the anastomosis which they helped to establish safely.

3. With a still functioning cecostomy, even though very small, a great element of safety

was added to the proposed occlusion of the transverse colon distal to the anastomosis. This cecostomy was soon to close spontaneously and the element of safety would not be there for a later operation.

4. This patient's abdominal tissues were most assuredly now immunized not only against several species of bacteria but also to trauma and handling.

5. An urgent desire on the part of the author to complete what he had planned for several months (hardly to be considered a justifiable cause for operation).

On February 16, 1942, eighty days after the end-to-side anastomosis, the final operation was undertaken. Under sustained spinal anesthesia a flank incision was made surrounding the colostomy, with a safe margin of skin at its mesial end and terminating at the end of the eleventh rib laterally. (Fig. 9.) The bridge of skin between the actual colostomy opening and the unhealed upper angle of the left paramedian incision (Fig. 9) was cut across and the undersurface of this bridge and the actual colostomy opening were closed with a short continuous suture. (Insert Fig. 12.) The elliptical incision as shown in Figure 9 was carried down through skin and subcutaneous tissues and its upper and lower wide flaps were tightly sutured over the top of the now closed colostomy opening. (Insert Fig. 12.) The abdomen was not reprepared; gowns and gloves changed and the operation continued.

The lateral end of the incision was now carried down to the external oblique aponeurosis and muscle. Dissection of the colostomy area was carried down until the abdominal cavity was entered, the dissection being made as far away from the gut as possible with the conservation of as much abdominal wall as possible. It must be borne in mind that at the first operation the presumed permanent colostomy was brought through the rectus muscle, hence in removing this colostomy the rectus was cut completely across as shown in Figure 12. The section of the lateral abdominal muscles and peritoneum was carried out so that the whole left upper and middle abdomen was laid wide open with excellent exposure. With the colostomy site entirely freed and with a most unexpected absence of adhesions the remainder of the operation was extremely simple and easy. The phrenocolic ligament was cut and the descending colon and splenic flexure were easily handled. The branches of the left colic artery were ligated, care being taken to avoid the inferior mesenteric and its superior hemorrhoidal branch. The peritoneum was incised and the gut freed. As the splenic flexure and left arm of the transverse colon were reached the vessels were ligated quite close to the gut to avoid inadvertently ligating a large branch of the median colic. The peritoneum of this gut, including the left half of the transverse mesocolon and gastrocolic ligament, was cut and the entire large intestine from colostomy to about two inches distal to the end-to-side anastomosis was now out of the abdomen. Gentle tension on this gut brought the site of the end-to-side anastomosis into view and the transverse colon was clamped not more than two inches distal to the distal end of the anastomosis. The transverse colon was cut across, and sutured and inverted and a second tier of sutures placed to assure absolute closure. The ends of this suture were allowed to remain long and were used to fix this stump to the undersurface of the anterior parietal peritoneum after its closure was nearly complete, this to

Fig. 15. This shows the condition of the remainder of the large intestine on March 6, 1942, eighteen days after the partial colectomy. The short ascending colon and hepatic flexure did not fill and contain air. The closeness of the anastomosis to the blind end of the transverse colon and the consequent almost complete absence of a distal colonic pouch are well shown. The barium was given per rectum.

produce an external fecal fistula in the event of postoperative leakage. The edges of the cut posterior parietal peritoneum were brought together from the lower end to the base of the remaining half of the transverse mesocolon. No attempt was made to suture the transverse mesocolon to the edge of the gastrocolic ligament. There is essentially no loose gut or other structure to herniate out of that space (Figs. 12, 13 and 14) and the author deemed it wiser to leave it wide open than to suture same and possibly leave a small hole through which something might herniate in. The abdomen was now closed, special attention being paid to the reconstruction of the rectus muscle and its sheath. The abdomen was closed tight without drainage. The operation had progressed so smoothly without any mishap that sulfanilamide was not used. Operative time was one hour and fifty-five minutes. The pathological report was: Thirty eight cm. of large intestine with a single diverticulum in its distal portion.

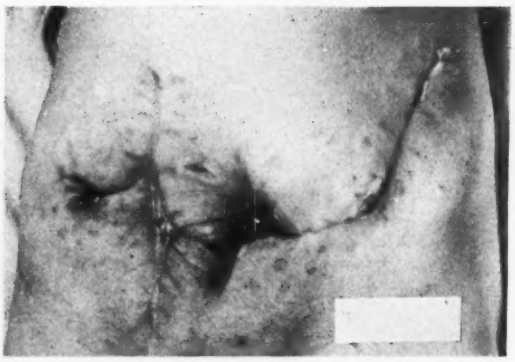

Fig. 16. Photograph of the abdomen taken a few days prior to discharge. By June 5th, the superficial areas, still unhealed at time of photograph, were completely healed and cecostomy tightly closed.

The postoperative course was most satisfactory. The maximum temperature was 101°F. and pulse 120 with gradual decline and a normal temperature and pulse of 80 on the fifth postoperative day. There was superficial colon bacillus infection at the old colostomy site with foul brown pus and slight necrosis. The bowels moved spontaneously on the third postoperative day. On the eighth day postoperatively the temperature rose to 101.4°F. On February 26th, ten days postoperatively a large but very superficial abscess localized in the upper lateral aspect of the wound. This was opened with a small separation of the incision with the copious discharge of frank yellow pus. Temperature immediately fell to normal and remained so for the duration of the hospital stay.

The patient was out of bed on March 1, 1942, thirteen days postoperatively. On March 6, 1942, eighteen days postoperatively, the condition of her large intestine was as shown in Figure 15. She was discharged March 7, 1942, twenty-one days after the colectomy and seven months from the day of admission, August 7, 1941. Her condition on discharge was excellent; the patient stated: "I feel better than I have felt in two years." Cecostomy was just about open. The bowels were functioning well. The wounds were healed with the exception of a superficial triangular area at the old colostomy site as shown in the photograph of the abdomen taken a few days before discharge. (Fig. 16.) Her weight was 119 pounds and her blood showed a hemoglobin of 70 per cent, red cells 4,000,000 and white cells 13,500 with 62 per cent polymorphonuclears.

Figures 13 and 14 described more fully under the legends accompanying same represent semi-diagrammatic anatomical drawings of the anatomy of the abdomen at the completion of the last operation. Copies of these drawings were filed with the patient's hospital record so that in the event of Mrs. J. M. ever suffering another abdominal catastrophe, the surgeon, be it the author or someone else, might have at least some guide by which to orient himself in the much changed anatomy. The author would like to point out that there are now two openings through which small intestinal herniation could take place. The upper one, the large new communication between the lesser and greater cavities formed by the blind end of the transverse colon, transverse mesocolon in back and gastrocolic omentum in front. There is no mobile organ within this upper space (lesser sac) which could possibly herniate from within out, but one might conceive the possibility of small gut in the major cavity herniating from without through this opening into the lesser sac. To the author it seems probable that with no increased pressure from within the edge of transverse mesocolon and the edge of the gastrocolic omentum will probably adhere and obliterate the opening. The lower opening is bounded anteriorly from below upward by the posterior surface of the rectum and rectosigmoid from the point of extraperitonealiza-

tion of the rectum, the remaining half of the transverse colon and the inferior leaf of the transverse mesocolon. The posterior boundary is the essentially intact posterior parietal peritoneum. The probabilities of the transverse mesocolon becoming adherent to the posterior parietal peritoneum and thus obliterating, *in toto* or in part, the upper portion of the major peritoneal space with the possibility of herniation of small intestine through an open area in such adhesions seems very slight particularly when you bear in mind that at the last operation the author fixed the stump of the transverse colon to the anterior peritoneum. At that time he did so to produce an immediate point of fixation for the formation of a fecal fistula to the outside in even of leakage of the stump. It is now quite evident, however, that entirely unintentionally, he held the colon stump and adjacent anastomosis and upper rectosigmoid anteriorly and in so doing also kept the transverse mesocolon and gastrocolic omentum from collapsing against the posterior parietal peritoneum. The probabilities of extensive adhesions or constrictions or herniation in the lower and pelvic portion of the greater sac do not seem very likely in view of the fact that the peritoneum here was untouched at the last operation and the trauma of the third operation (removal of tube and cyst and anastomosis) had entirely disappeared by the time of the last operation.

After the patient's discharge from the hospital she was treated at the author's office. On March 23, 1942, only gas passed per cecostomy; the triangular area was granulating. On June 5, 1942, she was completely healed and the cecostomy firmly closed. On October 10, 1942, the patient looked exceptionally well; her weight was 131 pounds. She stated that she ate everything with no sign of any discomfort and that her bowel function was perfect. The author has heard from her since only indirectly but the reports continue to be most satisfactory.

## CONCLUSION

1. This case presented an unusual and misleading history.

2. The physical findings and general appearance were suggestive of malignancy.

3. The *x*-ray was suggestive of malignancy in the colon.

4. The gross pathological picture of the sigmoid at operation looked almost typical of a perforated carcinoma of the sigmoid.*

5. Based on the four preceding factors the author performed a resection which the pathological examination showed to be unnecessary.

6. The subsequent operations were performed as dictated by the author's judgment; the case was singular and there was no precedent to follow. What was done was thought to be the best choice under the circumstances but the author does not even suggest that such was the case; he is merely reporting what he did do.

7. The case did terminate with an excellent intestinal function and a progressive state of good health.

8. The author states very frankly that for nearly seven months a large part of each day was devoted to this case. Most of the dressings (and they were not pleasant dressings) were performed or supervised by the author. But, with all that, the author believes that the fortunate outcome in this case was contributed to largely by a most co-operative, courageous and pleasantly disposed patient, an excellent and observing intern staff, a large measure of good fortune and preeminently to a most conscientious, interested, willing, co-operative and keenly observant nursing staff whose duties in this case over a period of months were anything but pleasant.† I feel certain that they deserve the greater part of the credit for the happy ending.

* The author's error in this operative pathological interpretation was, needless to state, not only a jolt to his surgical diagnostic acumen but also to his background in pathological training. From 1912 to 1920 the author acted as surgical pathologist to not less than four Brooklyn hospitals.

† When, in an intestinal case, among many details in the nurses report you find: "Patient had a spontaneous bowel movement which consisted of three pieces of dark brown stool the largest being about two inches long and an inch in diameter the other two pieces considerably smaller," then you can be pretty certain that that patient is being carefully watched.

# VOLVULUS OF THE ENTIRE SMALL INTESTINE AND ITS MESENTERY

## CASE REPORT

J. J. DECASTRO BARBOSA, M.D.
Surgeon, Getulio Vargas Hospital, Municipal Health and Assistance Department
RIO DE JANEIRO, BRAZIL

VOLVULUS of the entire small intestine is a type of intestinal obstruction that has many peculiar surgical aspects. The number of successfully operated patients is exceedingly rare.

### CASE REPORT

A white, married female, twenty-eight years of age, was admitted to the Getulio Vargas Hospital, complaining of intense intermittent colicky abdominal pain of three days' duration. Vomiting began shortly after the onset of pain and was progressively more frequent, finally becoming practically continuous and consisting only of liquid non-fecal material. Since the beginning of pain there had been no bowel movements.

The patient had been married when she was twenty-two years old and since had had a yellowish vaginal discharge, for which treatment had been incomplete. She had always had trouble with constipation. Appendectomy had been performed twelve years previously.

On admission the patient was acutely ill. Her temperature was 38°c., her pulse rate 104 beats per minute, and her blood pressure 110 systolic and 60 diastolic. Inspection of the abdomen revealed the absence of respiratory movements and a slight bulging at the umbilical area. There was an irregular operative scar over the abdominal wall. Percussion was painful and showed tympany over the whole abdomen. Liver dullness was absent. Palpation was especially painful around the umbilical area but there was no rigidity. The patient had intense rebound tenderness, particularly over the mid-abdomen. Nothing abnormal was found at the hernial orifices. A bimanual vaginal examination revealed tenderness of the left fornix. Examination of the respiratory and cardiovascular systems was essentially negative. A flat plate of the abdomen was reported as follows:

"Dilated loops of small intestine. Absence of fluid levels. Partial obstruction high up in the small intestine. Adhesions?"

A preoperative diagnosis was made of mechanical ileus, high up in the small intestine, probably due to an old postoperative band. Immediate operation was undertaken, under spinal anesthesia, after a brief preoperative treatment directed to correct the fluid loss and electrolytic balance.

A medial infra-umbilical incision was made. In the peritoneal cavity there was a small amount of serous fluid present. There were numerous omentovisceral and viscerovisceral adhesions. All the loops of the small intestine seemed to be equally distended and had a purplish blue color. Since the cause of the obstruction was not immediately found, a thorough exploration of the peritoneal cavity was made, beginning with the small intestine, which was examined from above downward, toward the cecum. All the loops were distended and had the same purplish blue color. In the course of this examination a thick and tense band was found, holding down a fixed, distended loop of small bowel. By the side of this loop, and also emerging from below this band, there was another loop of small intestine of normal color and diameter. Traction on this second loop brought out with ease several other loops of ileum. The incision was then enlarged and a massive evisceration of the whole small intestine was done in order to examine with greater ease and visibility this peculiar and inexplicable condition. It was then seen that the thick "band" was the mesentery itself twisted once round in a clockwise direction. Detorsion was effected by rotating the eviscerated mass of small intestine counterclockwise. The mesentery was found to be extremely long. The small intestine soon regained its normal color and contractility with the help of warm physiologic solution. The abdomen was closed

with two rows of running catgut sutures, and Michel clips were placed on the skin. No drain was placed in the peritoneal cavity.

After the operation, the patient seemed to be rather shocked, due to the extensive manipulation. However, her condition soon became very satisfactory. The vomiting ceased completely. On the following day the patient felt no more pain; the abdomen was slightly tender but, nevertheless, soft. The clips were removed on the eighth postoperative day. Healing was by first intention. The patient left the hospital twelve days after admission and was perfectly well until thirteen days after discharge, at which time she again came to the hospital, complaining of the same excruciating pains accompanied by vomiting. She was agitated. Her pulse rate was 104 beats per minute, temperature 36.6°c., and blood pressure 96 systolic and 60 diastolic. The abdomen was distended and tender and slightly rigid on palpation, especially on the lower half. The patient had not had a bowel movement for forty-eight hours, but shortly after admission had one and passed considerable gas. The pain and musuclar rigidity subsided completely two hours later. After eight days of medical care and observation she was dismissed, perfectly well.

## GENERAL CONSIDERATIONS

*Incidence.* A survey of the literature on the subject was made and twenty-seven papers were collected, all but two of which were published between 1920 and 1941. These showed very few successful cases. As to the incidence, one can say that it is very rare. MacClure, in 1935, collected thirty-seven cases from the medical literature. It is possible that the number of cases is greater, for some authors are not precise in giving a title to their reports. One should always specify that the case was of a volvulus of the *entire* small intestine if it happens to be so, and not simply say volvulus of the small intestine. In the Massachusetts General Hospital, in the space of twenty years, there were 239 cases of intestinal obstruction; twenty-five of them were due to volvulus, only ten of which were of the small intestine. Among these ten cases out of the total of 239, there was only one case in which the volvulus included the whole small intestine with torsion of the entire mesentery.

*Age.* As to age, one can say that volvulus of the entire small intestine is more common in adult life (average forty-five years), unless statistics are false, owing to the fact that many children die without a correct diagnosis.

*Sex.* There is, according to all statistics, a greater percentage of men who develop this condition than women.

*Degree of Torsion.* In most cases the degree of torsion is not more than 180°. The rotation is clockwise in the greater number of cases. Some authors, however, do not mention this detail. Others, on the other hand, use different terminology, such as "rotation from left to right." This is very misleading because one never can tell whether one is referring to the left of the patient or that of the surgeon.

*Etiology.* Many etiological factors have been suggested, such as structural changes; adhesions, congenital or those due to previous peritonitis; old scar formation or chronic mesenteritis; former operations (bands, adhesions); mesenteric cysts; habitual constipation; chronic intestinal stasis; long mesenteries with a longer range of motion during peristalsis; congenital development of mesenteric pedicle in the shortening of its vertical attachment to the posterior abdominal wall; short attachment of the mesenteric root; non-rotation of the common mesentery and large and small intestine during their embryologic development, which normally takes place during the fourth month of fetal life. There are predisposing factors, such as the presence of hernias. The *exciting cause* may be a blow on the abdomen, heavy lifting, or even disorderly peristaltic action. It has been said that the vegetarian races, such as the Slavs and Scandinavians, who have bulky diets, are apt to have atony of the intestines and consequent chronic distention, which predisposes to twisting of the gut. Other authors think that perhaps the twisting is provoked by the stimulating effect that the cellulose from several vege-

tables has in the peristaltic actions. Cases of volvulus in these countries are more common. Active purgation may also bring about volvulus.

*Symptoms.* There are no special and characteristic symptoms. The clinical picture is that of an acute mechanical intestinal obstruction. There is sometimes previous constipation or abdominal discomfort, and at other times no previous history. The abdominal bulging varies in degree. When there is an internal strangulated intestinal loop, there is generally a great and pronounced distention at a certain point (von Wahl). The intestinal coils situated above the obstacle are emptied by vomiting, those below are also found empty. When, however, the torsion includes the entire small intestine, all the loops are uniformly distended. This distention varies in degree on clinical examination, according to the lesser or greater resistance of the belly wall, which tends to hold back the tension of the intestinal gases.

Some authors mention the fact that there is no fecal vomiting in this type of ileus. That is a negative finding of little importance. As a matter of fact, the diagnosis of ileus should be made long before this ominous symptom ever occurs.

The intensity of the abdominal pain depends upon the rapidity of torsion, the extent of the volvulus, and the tightness of the twist.

The precise diagnosis of volvulus of the *entire* small intestine is clinically impossible. One can be satisfied with the diagnosis of mechanical obstruction of the small bowel of the strangulating type, which at times may not be without difficulty. Surgery should be performed without delay. Practically all successful cases are those in which the patients have been operated upon within the first forty-eight hours. Without operation, the number of deaths is 100 per cent.

*Diagnostic Operative Findings.* The diagnosis on the operating table is not as easy as one would imagine. In the case of partial volvulus, the disorder can be found easily enough; but in the case of a torsion of the entire small intestine, anatomical relations are so modified, and the intestinal coils are disposed in such a fashion that even an operative diagnosis can make itself extremely difficult, especially when one is not aware of the existence of this infrequent type of obstruction. Mignon, Delore, Kirmisson, and Debrie were unable to discover the cause of obstruction in their cases and simply closed the abdomen without re-establishing the fecal course. Needless to say, they were all fatal cases. Delbet himself confessed that in his first case he also could not figure out where the disorder was, and he also closed the abdomen without removing the obstruction. It is quite possible that many cases have passed without the correct postmortem diagnosis, which can be made only if the autopsy be performed in a correct manner, that is, one has to examine the intestine *in situ* as if one were operating.

Delbet, with the experience gained in his first case, made the operative diagnosis promptly in his second case. Although the great majority of surgeons have never seen a case, we think that they could very well make the diagnosis with the mere knowledge of the existence of this rare kind of volvulus.

On opening the peritoneal cavity, one is apt to find serous fluid. It is a common finding in every volvulus. All the intestinal coils show themselves uniformly distended and with evidence of vascular changes; they appear with a purplish blue color. Later on, more serious complications may be encountered. The twist may be tight and obstruct completely the mesenteric blood vessels, with a menace to the vitality of the whole small intestine. Gangrene may set in. Once the abdomen is opened, the intestinal loops tend to eviscerate spontaneously, due to the gaseous distention inside them. The cecum is found to be empty. The twisted mesentery can be detected only after evisceration *en masse.* One then encounters a thick and tense "band," underneath which pass two loops

of bowel. One has a fairly normal color and diameter, the other, right next to it, is distended and congested. Tesson, with this finding, did not hesitate to make the diagnosis in his successful case presented by Delbet at the Surgical Society of Paris meeting in 1907.

The best operative procedure should be simple detorsion, by rotation *en masse* in the opposite direction of the twist. Simple detorsion is all that has been found necessary. Folding and shortening of the mesentery has been abandoned and considered useless. Resection, of course, has to be done if, by any chance, the vitality of any segment is compromised.

Death, due to lack of operative treatment or operation performed too late, is brought about by injury to the sympathetic plexus from strangulation, absorption of toxins from the peritonitis, and physicochemical changes in the blood. Mortality after forty-eight hours is 75 per cent.

## SUMMARY

A twenty-eight year old white female was admitted to the hospital with intense intermittent colicky abdominal pain of three days' duration, followed by profuse vomiting. Physical examination revealed bulging around the umbilical area, an appendectomy scar, visible persitalsis, and rebound tenderness. On operation all loops of the small bowel were found to be distended and bluish. Massive evisceration of the small intestine revealed a thick, tense band that was found to be the mesentery itself twisted in a clockwise direction and holding down two loops of small bowel, one fixed, distended, and bluish and another normal in diameter and color. Simple detorsion was performed and the patient's recovery was uneventful.

From the preceding report of a case and general considerations, the following conclusions may be made: (1) The case reported is that of a very infrequent type of volvulus. Patients successfully operated upon are exceedingly rare. (2) Precise clinical diagnosis is impossible. The twist of the *whole* mesentery can be detected only at exploration. Before exploration, one can make only the diagnosis of acute mechanical intestinal obstruction of the strangulating type. (3) Even at exploration, the precise diagnosis can be difficult to make. It has been overlooked by many experienced surgeons. (4) Early operation is the most important factor for success. (5) All the coils of small bowel are found to be distended and showing vascular changes. The cecum is found empty. (6) The twisted mesentery can be detected only after evisceration *en masse*. (7) The twisted mesentery presents itself as a thick and tense band underneath which two loops pass, one distended and bluish and another with normal color and diameter. (8) Treatment should consist of simple detorsion with minimum trauma and in minimum time. (9) Without operative treatment, mortality is 100 per cent. (10) Authors must be precise in the reporting of their cases. One should mention torsion of the *entire* small intestine whenever the case happens to be so.

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# SURGICAL REMOVAL OF HUGE RETROPERITONEAL EPITHELIAL CYST*

## WITH ADENOCARCINOMA ORIGINATING IN THE LINING

LEWIS E. NOLAN, M.D.
Director of Laird Memorial Cancer Clinic

AND

WILLIAM R. LAIRD, M.D.
Head of the Department of Surgery, Laird Memorial Hospital

MONTGOMERY, WEST VIRGINIA

HUGE multilocular retroperitoneal cysts are of uncommon occurrence but, when they do occur, their successful removal presents a major surgical problem. The case studied by the authors was of interest from this standpoint and, in addition, presented unusual gross and histologic findings, difficulties in classification, prognosis and pathogenesis, and showed early malignant degeneration of the lining epithelium.

Cysts are classified in general by William Boyd[1] as retention cysts, cysts of new formation, cysts of developmental origin, and parasitic cysts. Non-parasitic cysts are observed in persons of all ages. Large single or multiple cysts from retention of bile are occasionally observed. Bayer[2] reported a cyst containing 13.5 pints of fluid; Aldous[3] 12 pints; North[4] 5 pints; and Doran[5] 2.5 pints. In each of the foregoing cases the cyst wall was of fibrous tissue with numerous bile ducts embedded in it. The lining was of cubical, cylindrical, or flat cells with desquamation of epithelium. Zahn[6] collected fourteen cases of cysts lined by ciliated epithelium. According to Moschkowitz,[7] this suggests an origin from congenitally misplaced aberrant bile ducts. Stoesser[8] described a solitary, non-parasitic cyst of the liver in a newborn, which was so large that it prevented normal delivery of the child. Ottenheimer[9] states that Moschkowitz reviewed the literature in 1906 and found eighty-five cases of solitary, nonparasitic cysts of the liver. The former, in his review of the literature, 1900–1927, reported eighty-one other cases. Orr[10] described a strangulated, non-parasitic cyst of the liver. He analyzed seventy-five cases from the literature and found that the correct preoperative diagnosis was made in only three instances. The condition is usually diagnosed as hydrops of the gallbladder, ovarian cyst, pancreatic cyst, or mesenteric cyst. Parry[11] completely dissected out a congenital cyst of the liver, covered the raw surface with fine catgut sutures, and closed the abdomen without drainage. Shattuch[12] described a cyst, with many ducts and minute cysts in the wall, containing a gallon of clear fluid. He interpreted this as an adenomatous cyst. Keen[13] successfully removed an 113 Gm., true multilocular cystadenoma made up of many cavities lined by cylindrical cells and supported by fibromuscular tissue. Siegmund[14] reported an isolated cystic mass forming a large part of the liver in which there were many areas suggestive of new growth of cubical cells. Ochsner[15] reported an unilocular, non-parasitic cyst attached to the undersurface edge and upper surface of the right lobe of the liver, lined with low columnar epithelium and filled with 3.5 gallons of murky fluid.

### CASE REPORT

C. F., a twenty-three year old white male was admitted to the Laird Memorial Hospital on February 13, 1941, complaining of dull epigastric pain. The patient stated that for as long as he could remember he had had

* From the Departments of Surgery and Surgical Pathology, Laird Memorial Hospital.

extremely heavy upper abdominal muscles. During the past few weeks there had been some pain in the epigastrium, which originated just above the umbilicus and radiated to the right supraclavicular area. The pain was accentuated by deep inspiration. He had noted some increase in the size of the epigastrium and a slight decrease in strength. There had been occasional frequency of urination but no history of hematuria, pyuria or other urinary symptoms. Recurrent attacks of sore throat and tonsillitis had been present for five years previous to tonsillectomy one year ago. He had had uncomplicated measles, pertussis, chickenpox, and diphtheria during childhood. There was no familial history of tuberculosis, cancer, epilepsy, diabetes, or insanity. Physical examination revealed a well developed and nourished white male, lying quietly in bed and not appearing acutely ill. The temperature was 98.0°F., respiratory rate 26, pulse rate 86, and blood pressure 136 systolic and 78 diastolic. The heart and lungs were normal. A tumor mass was palpated in the right abdomen extending from the costal margin to the crest of the ilium and just across the midline. The tumor mass was cystic to palpation and dull to percussion.

The urinalysis was negative. The erythrocyte count was 4,890,000, hemoglobin 71 per cent, total leucocyte count 11,000, polyneutrophils 81 per cent, lymphocytes 18 per cent, and monocytes 1 per cent. Sedimentation rate for the first hour was 74 mm. and for the second hour 105 mm., by the method of Westergren. Urea nitrogen was 9.0 mg. per 100 cc. of blood. Roentgenological examination showed the transverse colon displaced toward the left by the mass. By intravenous pyelograms the right kidney was found to be pushed to the left.

Operation was performed February 18, 1941,

FIG. 1. Huge retroperitoneal cyst; surgical specimen.

FIG. 2. Transection of cyst showing multilocular structure, and at the left cut surface of attached liver tissue.

for removal of a large retroperitoneal tumor. A long curved incision was made, extending from the costal margin laterally to the right rectus muscle to the anterior iliac spine. The abdominal cavity contained a small amount of serous fluid. A huge, gray, glistening tumor presented through the wound, covered by the peritoneum of the posterior wall of the abdomen, except for the attachment of the superior pole to the posterior surface of the right lobe of the liver. The liver had been pushed into the left upper quadrant of the abdomen, and the right kidney was rotated to the left and situated to the left of the spinal column. The tumor was brought through the wound with some difficulty. At this time the patient's blood pressure dropped and the pulse rate became extremely rapid. The tumor was carefully separated from the liver by sharp dissection and completely removed without rupture or drainage of the contents. The large raw surface over the posterior portion of the right lobe of the liver and posterior peritoneal incision were covered and closed with fine catgut sutures. After removal of the tumor the right kidney fell back into its normal position.

The postoperative course was rather stormy, with temperature elevation to 104.0°F., and formation of an abscess in the right lower quadrant of the abdominal wall. This was successfully drained by incision. Bacteriological study of the thin, gray pus disclosed streptococci. Sulfanilamide was administered. A second abscess, localizing in the cul-de-sac, was

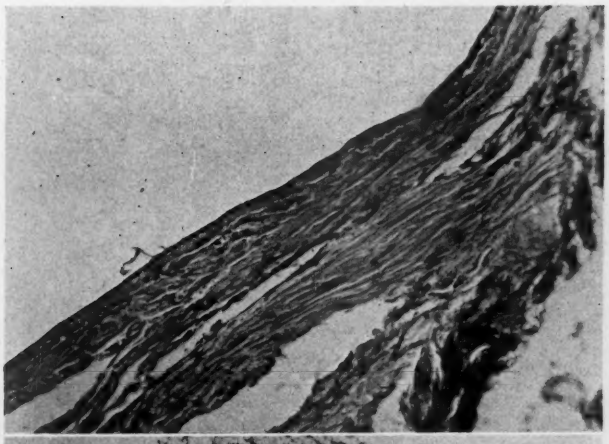

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Section of cyst wall lined with flat epithelial cells. Microphotograph × 265, U. S. Army Medical Museum, Neg. No. 73129, Accession No. 73089.

Fig. 4. Cyst lined with cylindrical epithelium in fibrous wall of larger cystic structure. Note resemblance to bile duct formation. Microphotograph × 265, U. S. Army Medical Museum, Neg. No. 73127. Accession No. 73089.

Fig. 5. Note infiltration of inner part of cyst wall by atypical epithelial cells. Microphotograph × 265, U. S. Army Medical Museum, Neg. No. 73131. Accession No. 73089.

treated in the same manner. Postoperative roentgenological examination by Graham-Cole method showed the gallbladder clearly visualized, long, narrow, and apparently fixed to the liver in a transverse position with the tip bent upward and laterally. By intravenous pyelograms the kidneys were found to be normal in shape, size and position.

FIG. 6. Metastatic adenocarcinoma in the liver with subacute hepatitis. Microphotograph × 75.

The patient was discharged from the hospital, apparently in good condition. He returned to his usual work and worked continuously as a laborer during a period of thirty-five days. Five months after the removal of the cyst he was readmitted, complaining of dull, aching pain in the left upper quadrant of the abdomen. His temperature was 100.8°F. and pulse rate 88. There was tenderness on palpation high in the left upper quadrant of the abdomen but no masses were palpated. His course in the hospital was febrile and retrograde with a spiking temperature, ranging between 101.0°F. and 104.6°F. Hematological survey at this time disclosed erythrocytes 3,050,000, color index 0.75, hemoglobin 45 per cent, total leucocyte count 44,000, differential count 94 per cent polymorphonuclears and 6 per cent lymphocytes. His condition became more critical in spite of repeated blood transfusions, and the temperature was subnormal for several days preceding death, nine months after discovery of the tumor.

The pathological specimen was an oval, whitish-red, cystic tumor mass, removed intact, which weighed 9,080 Gm. and measured 37.0 by 27.0 by 15.0 cm. The capsule was fibrous and smooth except for a roughened area, 14.0 by 18.0 cm., corresponding to the attachment to the liver. This area contained a pale, firm, yellowish-red, oval mass, 3.0 cm. in length and 2.5 cm. in diameter, with a smooth surface, attached to the capsule of the cyst by dense fibrous adhesions. The cyst was multilocular and contained 7,540 cc. of pale brownish fluid with a specific gravity of 1.004. The largest of the cyst cavities measured 29.0 by 26.0 by 12.0

cm. These cavities were numerous and measured on the average from 0.5 to 8.0 cm. in diameter, but no communication could be demonstrated between them. The capsule of the cyst and the cyst walls measured from 4.0 to 8.0 mm. in thickness and were made up of dense fibrous connective tissue. The cysts were lined by a glistening grayish membrane, smooth over most areas, but somewhat roughened and ulcerated in a few places. There was no evidence of coccidiosis. (Figs. 1 and 2.)

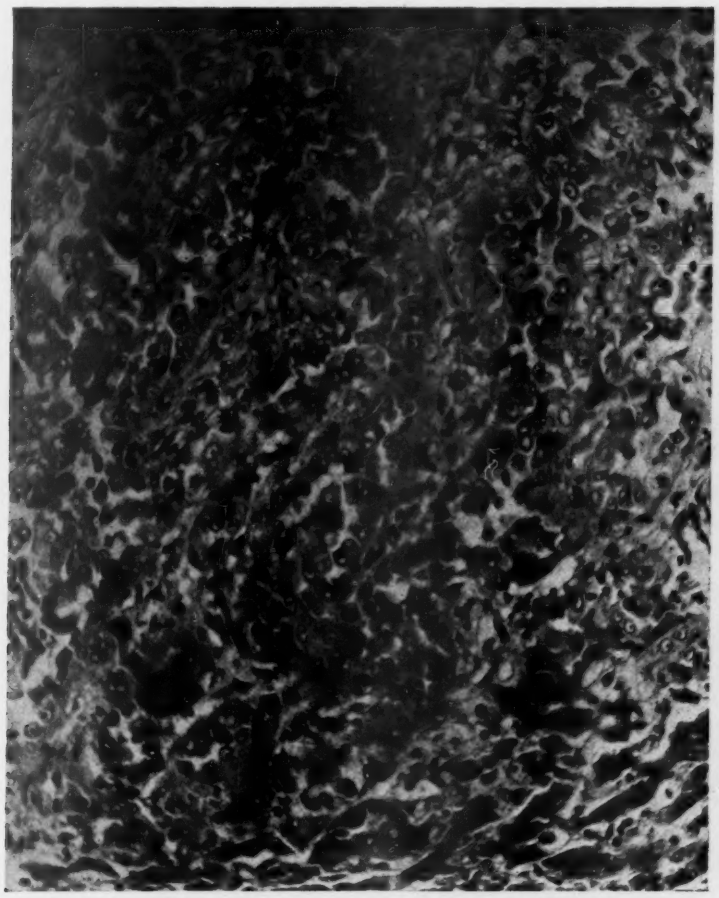

Fig. 7. Metastatic adenocarcinoma in the liver. Microphotograph × 400.

Microscopical examination of slides revealed the cyst lined largely by low, medium and high columnar epithelium, in a few areas drawn into low papillary folds projecting into the lumen. The nuclei were oval and situated at the base of the cells with the long axis perpendicular to them. The cytoplasm was pinkish and contained vacuoles. In other areas the cells appeared stretched and were of cuboidal or flattened epithelium. In a few areas the lining epithelial cells formed elongated layers resting on dense hyalin tissue, and extending into the fibrous stroma of the capsule separated by hyalin and connective tissue fibers, giving a laminated appearance. There were mononuclear cells with small nuclei and small amounts of fibrin adherent over the rough ulcerated areas. The wall of the cyst was made up of areas of smooth muscle with numerous small ducts lined with columnar epithelium with structure similar to that of small bile ducts. The ducts varied in size. Some of them had scarcely any lumen while others formed saccular spaces. The fibrous stroma of the wall contained fibroblasts and was infiltrated with scattered polymorphonuclear neutrophilic leucocytes, small lymphocytes, and mononuclear cells. There were small aggregations of lymphocytes in some areas. A study of the sections from the yellowish-red, rounded area of tissue adherent to the capsule of the cyst disclosed it to be made up of liver tissue densely adherent to this capsule. It contained a small adenomatous nodule of hepatic

cords and other areas of compressed hepatic cords surrounded by fibrous connective tissue proliferation and was infiltrated with exudative cells, chiefly polymorphonuclear neutrophilic leucocytes, lymphocytes, and histiocytes, containing brownish pigment. In other areas the liver presented a smooth resected surface, densely adherent to the cyst wall. In the part of the liver adjacent to the cyst wall the trabeculae were widened and contained fibrous connective tissue infiltrated with exudative cells. In focal areas the epithelial lining of the cyst wall was replaced by proliferating atypical epithelial cells, which formed elongated cords parallel to the cyst wall, and infiltrated the inner one-half of the wall with imperfect alveolar segments. The nuclei of the cells were hyperchromatic with large nucleoli. Occasional mitotic figures were observed. A careful search was made in the fluid from the cyst and in the cyst wall for the hooklets of taenia echinococcus. None were found.

Histopathological Diagnoses: Huge multilocular, retroperitoneal epithelial cyst; aberrant liver tissue adherent to cyst wall with pressure atrophy and chronic proliferative and exudative inflammation; focal areas of very early adenocarcinoma, grade 1, originating from epithelial lining of cyst. (Figs. 3, 4 and 5.)

Necropsy examination disclosed 1,000 cc. of clear yellow fluid in the peritoneal cavity. The liver weighed 4,800 Gm. and extended to the level of the umbilicus. There were numerous whitish-yellow nodules, 0.3 to 3.0 cm. in diameter, throughout the liver. The gallbladder and bile ducts were normal. The spleen was pale red, soft, and weighed 425 Gm. The kidneys were normal. The gastrohepatic mesenteric lymph nodes were moderately enlarged, gray and infiltrated with tumor tissue. There were several flattened whitish-yellow tumor nodules in the visceral pleura of both lungs, measuring 0.5 to 0.8 cm. in diameter. The lung surface was deep red and congested. The myocardium was deep brown and the heart weighed 221 Gm. There was no free fluid in the pleural cavities. Careful examination of all the organs did not disclose any primary source of the tumor other than the cyst previously removed.

Microscopic examination of sections from the liver showed tumor nodules fairly sharply demarcated from the liver tissue, made up of atypical epithelial cells in an imperfect alveolar arrangement, the formations suggestive of small ducts and acini. The nuclei were rounded and oval with a hyperchromatic vesicular pattern. No mitotic figures were observed. The pleura and mesenteric lymph nodes contained similar nodular formations of atypical epithelial cells. Additional findings were subacute hepatitis, bronchopneumonia, and chronic splenitis. The anatomical diagnosis was: Adenocarcinoma, primary, epithelial lining of retroperitoneal epithelial cyst, with metastasis into liver, mesenteric lymph nodes and pleura.

## COMMENTS

From the gross and microscopic features it was evident that we were dealing with a huge multilocular cyst filled with clear, pale brown fluid, with a rather thick wall made up of dense fibrous connective tissue containing small areas of smooth muscle and acinar formations of columnar epithelium suggestive of small bile ducts. The cyst was lined in some areas with fairly tall columnar epithelium and in others with cuboidal or flat epithelial cells. There appeared to be a very early malignant degeneration in some areas of the lining epithelium with a downgrowth of cord-like formations and imperfect alveoli of atypical dark-staining epithelial cells. The cyst was attached to the right posterior lobe of the liver over a wide area with the bulk of the mass in a right retroperitoneal position, pushing the right kidney across the midline of the body. The cyst wall contained areas of chronic inflammation which may account for the stormy, febrile postoperative course and multiple abscess formation. From the appearance of the cyst lining, wall, contents and position this did not appear to be a chylous, enteric, or dermoid cyst of the peritoneum, mesentery, or omentum.

Many cysts with single or multilocular structure, involving the mesentery and adjacent regions, may belong to the group of intraperitoneal cysts of nephrogenic origin. The contents of this type of cyst are brownish, serous, pseudomucinous fluid. The wall is composed of fibrous tissue and the lining of high cylindrical or cuboidal glandular epithelium. These cysts are

probably derived from the aberrant remains of the Wolffian body. Another possible origin of this cyst which seems more probable from its structure is that it developed from congenitally misplaced, extrahepatic, aberrant bile ducts. According to Moschkowitz, such ducts are embryonal rests found in the course of development of the liver. The lining of cuboidal medium and tall columnar epithelium, smooth muscle in the fibrous cyst wall, the intimate attachment to the liver, and the presence of acinar structure in the wall, support this view.

## SUMMARY

1. An unusual case of huge multilocular retroperitoneal cyst is reported with a review of the literature.

2. The most probable origin of this cyst is from congenitally misplaced, extrahepatic, aberrant bile ducts.

3. Such structures may give rise to neoplasms through malignant transformation of the cells in the wall or lining of the cysts.

4. Large cysts are a hazard to the life of the patient both from the danger of rupture and from the standpoint of a focus of chronic inflammation.

5. Complete surgical removal without rupture of the cyst is highly desirable both from the standpoint of the wound contamination and because of the possibility that the cyst lining or wall may be the site of a malignant tumor.

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# MEGACOLON ASSOCIATED WITH VOLVULUS OF TRANSVERSE COLON*

J. D. MARTIN, JR., M.D. AND CHARLES S. WARD, M.D.
ATLANTA, GEORGIA

THE first description of megacolon is usually ascribed to Hirschsprung in 1866 and sometimes bears his name. However, it has been shown that this condition had previously been recognized by Mya and others. Finney,[1] in 1908, reviewed the condition and described the pathological aspects but did not contribute an etiology of the disease.

An agreement is now held as to the general aspects. There is usually a uniformly enlarged, dilated colon. However, in some only segments of the colon are involved. It is within and associated with the segmental form that mechanical obstruction such as volvulus may occur. The dilatation is thought to be a progressive one in which there eventually develops a loss of motor activity of the intestine. The musculature and the remainder of the intestinal wall develop hypertrophic changes which occur in spite of continued dilatation. There is not infrequently found an associated obstructive lesion within the wall of the gut which accounts for the acquired forms. These obstructions may either be due to an inflammatory stricture or a long-standing annular malignancy of the lower large intestine.

Fenwick,[2] in 1900, proposed the developmental theory with associated dilatation and hypertrophy of the colon. Following this there were many proponents of the mechanical idea that the condition was associated with atresias, valves in the rectum and anus, which produced spasms and were followed by dilatation of the colon and elongation of the mesentery.

In 1895, Langley and Anderson[3] proposed the first possible etiological factors relative to the present knowledge of the disease. It was noted that stimulation of the lumbar sympathetic ganglia caused an inhibition of peristalsis with a dilatation of the colon. Prior to this period the lesion was thought to be due to inflammation of the colon, enlargement of the colon, actual mechanical obstructions, and congenital aplasia of the muscular tissue.

The neurogenic theory is based on definite physiological reasoning. It is assumed that there is a reflex spasm of the internal sphincter in the absence of a gross obstructive lesion. There is a relaxation of the internal sphincter and a paralysis of the bowel. This is tenable with the knowledge that stimulation of the sympathetics causes a contraction of the bladder and rectum and a dilatation of the walls of these viscera. It is assumed that in normal health these structures are functioning harmoniously in allowing the filling and emptying of the viscera. Depression of the parasympathetic or a stimulation of the sympathetic systems would produce a megacolon.

Wade and Royle,[4] in 1925, performed a lumbar sympathectomy for megacolon which was soon followed by others.[5] Adson and Bergen[6] made a distinction between the types of the disease and were particularly interested in the control of constipation in the atonic forms. A bilateral resection of the first and second lumbar ganglia and the splanchnic nerves was done. A resection of the superior and inferior mesenteric ganglia and presacral nerves were denervated only in the distal half of colon. The cephalad portion is controlled by the postganglionic fibers from the celiac plexus and mesenteric ganglia. It is, therefore, necessary in order to remove the

* From the Department of Surgery, Emory University School of Medicine.

inhibitory influences of the sympathetics completely to include all of these nerves.

Adamson and Aird[7] proposed experimental evidence performed on cats to support the neurogenic theory. Resection of the parasympathetics to the distal colon produced a progressive megacolon.

Burrows[8] noted that following injection of silica into the mesentery of the cecum of rats there developed a marked enlargement of the colon. It was assumed that this substance came in contact with the sympathetics and not the parasympathetics and produced a stimulation of the sympathetic nerves.

The diagnosis of this condition is accomplished both in the acquired and congenital forms without much difficulty. In the congenital form the enlargement of the abdomen is present from birth or soon thereafter. There is always considerable difficulty in having a normal bowel movement.

Development may be progressive, associated with marked atony of the large intestine. Roentgenograms should determine the presence of atresias, valves, tumors, inflammations, or other organic disease. Blocking the sympathetics by the administration of spinal anesthesia readily demonstrates the existence of a functional muscular atony (Stabins[9]). This temporarily interrupts the reflex and allows the motor activity to occur with an improvement in motility. This, is, therefore, beneficial preoperatively to determine the results before section of the lumbar sympathetics.

Prior to 1925 all therapy was directed toward the local condition. At first, diets, enema and colonic irrigations were tried with indifferent success. Many forms of exercise and binders were used with very little benefit. More recently, with knowledge of the chemical changes that occur in the synapses of the automatic nerves, acetylcholine and similar drugs have been advocated. Pituitrin, pilocarpine, physostigmin, prostigmin, parathomone, arsenic, and iron have been given.

Klingman[10] states that the toxic action of the various drugs used to remove the cholinergic substance within the nerves limits their usefulness and benefits. Syntropan[10] was advocated because it had the

Fig. 1. Preoperative roentgenogram of the abdomen which shows the megacolon.

action of atrophine to stop this cholinergic action but did not have its toxic and drying effects. Prostigmin and physostigmin intensify the action of acetylcholine through prolongation of its activity by preventing the cholin esterase from destroying the acetylcholine. This is accomplished in the absence of disturbance of the rectosigmoidal apparatus. It is concluded that selective drug therapy has proved effective when neurogenic imbalance has been established because of defective inhibitions or motor functions of the parasympathetic system.

de Takats[11,12] used various drugs to lessen the inhibitory influence of the sympathetics and to stimulate the parasympathetics to increase peristalsis and to relax the sphincters. When there is no improvement after three years of conservative treatment, surgery is advised.

Since Wade in 1925 advocated sympathectomy many forms of surgical therapy have been used. This, in part, may be due to lack of knowledge concerning the sympathetic and parasympathetics. Telford and Stafford[13] attempted to clarify the knowledge of these structures. There is

yet considerable vagueness in regard to the parasympathetic arrangement.

The sympathetic cord is supposed to be derived from segments from the second thoracic to the third lumbar. Therefore, wide ranges of operative procedure are performed; perivascular sympathetic or aortic plexus and inferior mesenteric sympathectomies, lumbar sympathectomy, ramisectomy of the medially directed rami, and resection of the presacral nerves. The use of the latter procedure has the disadvantage of producing the loss of ejaculatory functions. Weeks[14] advocates, therefore, in younger individuals ganglionectomy, and some type of resection in older individuals.

In the presence of gross obstructive pathological lesions surgical care must be directed to the local problem.[15] Dilatations of the anal sphincter, correction of fissures, removal of valves and atresias should be beneficial where there is no derangement of the autonomic nervous system.

The size and mobility of a megacolon may allow a volvulus to occur. It is for this reason primarily that resections of the colon, either in part or totally, are undertaken. This report is concerned with a problem of this nature. With the use of sulfonamides, particularly succynil sulfathiazole, resection of the colon can be accomplished with less mortality and morbidity. If the megacolon becomes acutely obstructed, operative treatment is imperative; and the protective benefit of this form of chemotherapy cannot be obtained at the time of operation.

FIG. 2. Resected specimen of transverse colon which constituted that part of the volvulus.

## CASE REPORT

J. B., age twenty-two, a white, male, gave a history of having a marked enlargement of the abdomen all his life. He had no difficulty until 1939, when he was admited to Emory University Hospital by Dr. William H. Trimble. On admission there was marked abdominal pain, nausea, vomiting and distention. The treatment consisted of mecolyl bromide, hot fomentations, colonic irrigations and supportive measures. Under this treatment he improved but remained in the hospital for several weeks. He did fairly well until March 2, 1942, when he began to have cramp-like pains in the abdomen, marked distention, nausea and vomiting. A Miller-Abbott tube was inserted, fluids were given intravenously, and some improvement

was noted. On March 22, 1942, the pains became more severe and distention was more marked. The same measures as had been previously used were instituted, but the patient became progressively worse. When seen on March 27, 1942, the pain was of the peristaltic type. There was marked dehydration and the abdomen was tremendously distended.

Fig. 3. Shows barium enema in the lower segment of colon after colostomy. The point of constriction is noted below the colostomy.

On March 28, 1942, under spinal anesthesia, a long upper left rectus incision was made. On opening the abdomen the large intestines were enormously distended. The transverse colon was rotated near the splenic flexure one complete time. There was an old adhesion which extended horizontally across to the transverse mesocolon. This was released and the volvulus untwisted. Due to the extreme thickening and friability of the gut, a resection of this portion was done. The ascending colon was sutured to the descending colon and the mesocolon mobilized. The clamps were placed on the ascending colon and the upper descending colon and the intervening segment was excised. The ends of the gut were brought on the abdominal wall with the clamps in place. The abdomen was then closed around the proximal and distal stomata. The patient reacted very well from this procedure. He was given 500 cc. of .8 per cent sulfanilamide subcutaneously and 200 cc. of .8 per cent sulfanilamide were given subcutaneously every eight hours.

The convalescence from this procedure was uneventful. The clamp on the proximal side of the colon was removed on the fourth day. A crushing clamp was placed on the spur of the colostomy, which cut through, but no feces were passed normally. The patient was allowed to leave the hospital using a colostomy bag. He was readmitted to the hospital July 15, 1942, for closure of the colostomy. After readmission a barium enema revealed an enormous dilatation of the sigmoid colon. About three inches below the site of the colostomy stoma an annular constriction was noted, through which no barium could escape.

Fig. 4. Photograph of the opened descending colon, noting the site of the intrinsic annular inflammatory stricture.

On July 18, 1942, an elliptical incision was made around the colostomy, which had been temporarily closed. The peritoneal cavity was opened and the site of the colostomy delivered. About two inches below the opening of the colostomy the constriction in the sigmoid was noted. Below this point the gut was thickened and dilated. The remaining portion of the ascending colon, cecum and appendix were dilated and hypertrophied. Due to the extensiveness of the disease and the obstruction, the remaining portion of the colon was resected. A side-to-side anastomosis of the rectum and terminal ileum was done. Nine Gm. of sulfanilamide was placed in the abdominal cavity, which was closed without drainage. Convalescence was uninterrupted. On the seventh day postoperatively the patient passed a soft liquid stool and had soft bowel movements thereafter. Convalescence continued normally and the patient was dismissed from the hospital August 12, 1942.

Histological examination of the resected colon and the site of the constriction revealed

an inflammatory process. There was no evidence of malignancy.

## COMMENT

Considerable experience has been gained to evaluate the present treatment of megacolon. The progressive congenital neurogenic type can be improved with lumbar sympathectomy in the absence of gross pathological defects of the colon. These defects are not infrequently an accompaniment of these lesions and must always be determined prior to undertaking any form of therapy.

The use of drug therapy is temporarily beneficial and is an aid in determining the type of lesion. The toxicity of most cholinergic drugs prohibit using them over a long period of time. If there is a failure of improvement after the administration of acetylcholine, prostigmin and similar drugs, or following the administration of spinal anesthesia, it is evident that some gross lesion is present and must be corrected. It is possible for a gross pathologic process to be associated with an imbalance of the autonomic nervous system.

If there is failure of response to a nerve bloc, an exploration perhaps should be undertaken. The elongation and enlargement of the colon will allow the production of a volvulus. The sigmoid colon is the most frequent site of volvulus, due to its normal mobility. However, all segments can assume such an obstruction and cause serious consequences. Due to the multiple blood supply of the colon, volvulus does not cause gangrene as frequently as it would in the small intestine. However, if the rotation is complete and associated with an infection, it may produce a segmental necrosis.

## SUMMARY

1. A review of the physiology and pathological anatomy of megacolon is presented.

2. The methods of classification and diagnosis of the condition is outlined.

3. The medical and surgical treatment is summarized.

4. A case is reported in which the patient developed an acute volvulus, necessitating resection of the transverse colon.

5. The etiological factor was shown to be an inflammatory constriction of the descending colon. This was corrected by the resection of the remainder of the colon. A successful anastomosis of the terminal ileum to the terminal colon was performed.

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# RUPTURED MUCOCELE OF THE APPENDIX WITH PSEUDOMYXOMA PERITONEI*

FRANCIS X. TIMONEY, M.D.
Visiting Surgeon, St. Vincent's Hospital
NEW YORK, NEW YORK

IN a seven-year review of the pathological records of St. Vincent's Hospital, the occurrence of mucocele appeared four times in 3,087 appendectomies, and once in 760 adult autopsies, thus giving an incidence of 5 or .13 per cent in a total of 3,847 cases. In a six and one-half-year review of the American literature, beginning July 1936, cases of mucocele of the appendix were sporadically reported. The number of reported cases gathered by various authors is now approximately 500. During this six and one-half-year period I have been able to gather only six reported cases of ruptured mucocele. Waugh and Findley,[1] Doyle,[2] Morgan,[3] Chaffee and Le Grand,[4] Hall[5] and Willcutts and Henkel[6] have each reported one case of ruptured mucocele.

The incidence of mucocele of the appendix given by different authors varies from 2/10 to 3/10 of 1 per cent. It is generally agreed upon that pseudomyxoma peritonei of appendiceal origin is rare. The etiology is unknown. Acute attacks of appendicitis may be followed by proximal occlusion of the lumen of the appendix. The production of mucus may increase and cause a cystic swelling. There may be herniation of the mucous membrane through the muscular coat, producing diverticula of the appendix. These may rupture and the mucoid contents may be spread by intestinal peristalsis and grafted upon the serous surfaces of the peritoneal cavity. Morgan states that 50 per cent of the patients who come to surgery give a history of pain, discomfort or other variable symptoms referable to the right lower quadrant. In advanced cases a mass might be felt, as in the case to be reported. In this case, a roentgenogram with contrast enema showed incomplete filling of the cecum, (Fig. I.) LeWald[7] may have been the first to interpret this defect accurately, having made the diagnosis by *x*-ray, which was confirmed at operation. The patient in this unreported case was operated upon by Lyle[8] at St. Luke's Hospital, New York City, and was presented before the Surgical Section of the New York Academy of Medicine twenty-four years ago.

The treatment is surgical, consisting of removal of the appendix and mucocele and all secondary implants, if possible. I do not believe that the value of *x*-ray therapy, which is occasionally recommended, has been definitely established in this condition. Jackson[9] states that the removal of a mucocele appendix may possibly stop the spread of pseudomyxoma implants in the peritoneum. He likens it to the occasional case following the removal of a mother ovarian pseudomucinous cyst with spontaneous subsidence of secondary implants after removing the primary tumor.

## CASE REPORT

H. H. S., a male, age forty-six, was admitted to the First Surgical Division of St. Vincent's Hospital on September 30, 1940. He stated that six days before admission he had generalized abdominal pain with occasional localization of pain in his right lower quadrant. There was no nausea or vomiting. A similar episode had occurred eight months before which had lasted ten days. His white blood count was 13,100 with 55 per cent polymorphonuclears. He was observed for four days. He then signed

* From the First Surgical Division, St. Vincent's Hospital. Presented before the Section of Surgery, New York Academy of Medicine, November 7, 1941.

a release and went home. The diagnosis was chronic recurrent appendicitis. He again entered the hospital on February 10, 1941. His chief

Fig. 1. Roentgenogram with contrast enema, showing incomplete filling of cecum. Gallstone showing above hepatic flexure of colon.

complaint was dull constant pain in the abdomen of two months' duration. He also noticed bright red rectal bleeding. His weight loss was twenty-five pounds in the past six months. His past history seemed to bear no relationship to his present complaint. His systemic review was essentially negative. Physical examination showed that he was markedly underweight. He appeared to be chronically ill. Examination of his abdomen revealed a small, firm, palpable mass in the right lower quadrant, 5 cm. medial to the right anterior iliac spine. Proctoscopic examination revealed a prolapsed, ulcerated internal hemorrhoid. The sigmoidoscope was passed for 25 cm. This revealed no discernible cause for bleeding other than internal hemorrhoids. *X*-ray studies of his gastrointestinal tract and gallbladder were made. The most important findings were, one gallstone, no visualization of the appendix, and a slight deformity of the cecum. It could not be determined whether this deformity of the cecum was inflammatory or neoplastic. The routine laboratory tests were performed. These were within normal limits. The tentative diagnosis was: (1) chronic cholecystitis with cholelithiasis; (2) chronic appendicitis; (3) possible malignancy of the cecum.

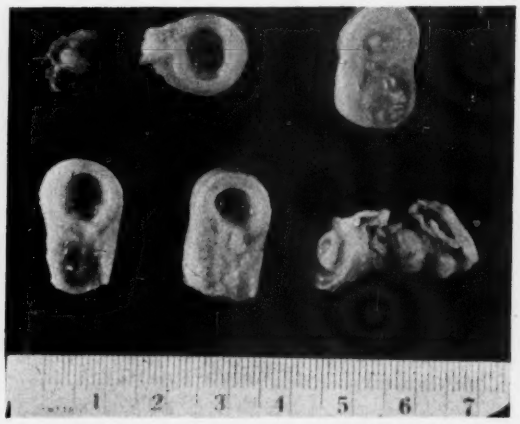

Fig. 2. Gross sections of thickened mucocele appendix with mucus filled cavities in both appendix and meso-appendix.

Fig. 3. Appendix; microscopic section. × 4.

Operation was performed on February 25, 1941, under cyclopropane ether anesthesia. The operative findings consisted of a gray, thickened, and somewhat enlarged gallbladder containing a solitary stone, and a thick appendix of firm consistency, 6.5 cm. in length and 3.0 cm. in diameter. It was densely adherent and closely attached to the parietal pelvic peritoneum. The induration of the appendix extended to the wall of the cecum. Distal to

the appendix but connected with its tip was an ovoid tumor 2.5 cm. in diameter. Distal to this tumor mass there was another ovoid tumor, slightly larger than the former in size. This latter tumor was adherent on one side to the middle tumor, and on the other side it was attached and incorporated in the wall of the large intestine at the rectosigmoidal level. The masses were seen to contain a mucoid material. The mucocele appendix, the pelvic parietal peritoneal and the rectosigmoid implants were removed and a cholecystectomy was performed.

The pathological specimens were submitted to Dr. A. Rottino. He reported as follows:

Specimen (1) is an appendix, 6.5 cm. in length, having a moderately congested serosa. (Fig. 2.) On section, one finds a long sac within the meso-appendix filled with a glairy colorless, gelatin-like material. At one point a narrow tract connects this cavity with the lumen of the appendix. The wall is thick and the lumen small.

Specimen (3) is a small, irregular, red piece of tissue with adherent gelatinous material. Embedded in this material are numerous small white bodies.

*Microscopic: Appendix:* The wall of the appendix is diffusely infiltrated with eosinophils. The serosa is thick and fibrotic. (Fig. 3.) Very interestingly, the mucosa of the appendix continues into the cavity described above. Much of it, however, is ulcerated in the cavity. Here also the submucosal tissue in places is infiltrated with round cells and eosinophils. Its wall consists entirely of fibrous tissue. No muscularis is present. In the serosa is a very much thickened blood vessel.

The third specimen consists of fibromuscular tissue containing irregular cavities filled with mucin. (Fig. 4.) There is no evidence of colloid carcinoma. This latter mass suggests pseudomyxoma peritonei. Diagnosis: (1) chronic cholecystitis and lithiasis; (2) chronic appendicitis, diverticulum, mucocele; (3) pseudomyxoma peritonei.

After operation the patient developed a postoperative pneumonia which responded satisfactorily to chemotherapy. Otherwise, his convalescence was satisfactory and he was discharged on his seventeenth postoperative day. He was last seen by me on October 16, 1941. He had regained his lost weight. Examination of his abdomen revealed a well healed wound. No masses could be felt. Digital rectal examination revealed no evidence of recurrence.

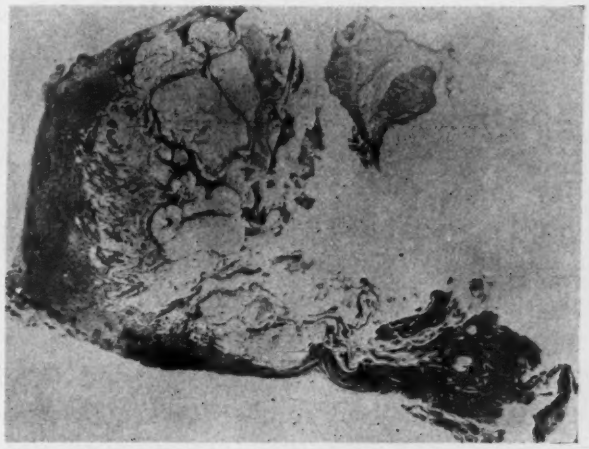

Fig. 4. Pseudomyxoma implant on rectosigmoid; microscopic section; × 3.

## CONCLUSION

1. Ruptured mucocele of the appendix is of infrequent occurrence.

2. Effort should be made to remove the mucocele and its implants, if at all possible. This is important because of its local invasive tendencies.

3. Through the fortunate circumstances of only local spread, a case of removal of a ruptured mucocele with its implants is hereby recorded.

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## ALBERTUS MAGNUS (1193–1265)

### INCUNABULA MEDICA VII

FELIX CUNHA, M.D.
SAN FRANCISCO, CALIFORNIA

THE name Albertus Magnus, "Albert the Great," or Albert von Bollstadt, is that of one of the three most celebrated and famous thinkers of the Middle Ages. In the large number of scientific manuscripts, treatises on philosophy, medicine, etc., which appeared during the thirteenth and fourteenth centuries, there is hardly one in which mention is not made of Albertus Magnus. The degree to which he influenced later years can be judged in a way by the fact that even to this very day the religious peasantry of Europe know and have heard of the name of Albert the Great, but usually he is known to them in the rôle of an astrologer or magician.

It is not difficult to understand this conception, since in the era in which he lived, people were still in a more or less semi-barbarous state. Cabalistic signs and magic were a part of the prevalent ideas explaining common everyday phenomena, and superstition was imbedded in every act of daily life and practice. All classes of people, the nobility, the clergy, the scientists, as well as the poor and the ignorant, believed in magic. Although severe and strict laws were leveled at sorcerers and at anyone accused of having dealings with sorcerers, witchcraft was a problem for several additional centuries beyond the thirteenth, as history shows.

The people were accustomed to seeing the priests seriously engaged in contemplating the sky and charting the course of the stars. According to their own particular mood and belief they were apt to either accuse the studious one of being a sorcerer or credit him with being a true astrologer who studied the influence of the stars on human conduct.

If a man occupied himself with natural history, or if he had chemical and physical laboratory paraphernalia, or were out in the country or woods engaged in collecting plants or minerals, he was either credited with being an alchemist engaged in the transmutation of metals or condemned as a magician in league with the devil.

The laity had another reason for thinking always of Albertus as a magician because the painters of the Middle Ages represented him in their works always as an alchemist or an astrologer, consulting the stars or working with an alembic. Usually they painted him standing or sitting near a table on which were many types of minerals, books, manuscripts, etc. Other artists depicted him in a church pew, deeply absorbed in prayer or meditation, but always present in the same minor detail was the background of alchemy or astrology. He was always made to appear as a pale thin individual of small stature, but actually his entire physiognomy denoted a strong will and utmost perseverance.

Strange miracles were attributed to him and many stories were related to tell of these. One was that he had constructed a human head which was able to speak. This came about from the fact that he had built or had attempted to build a "mechanical being" but it was constructed of iron, perhaps the first attempt at constructing our modern robot. But the laity, in their superstition and ignorance, attributed to this

robot the power of speech and thinking. Then the story was told that Thomas Acquinas, his famous and illustrious pupil, shattered the work because he considered it an agent of the devil.

Another story built out of superstition was that on one occasion in the dead of winter, with the ground covered with snow, William, the Roman Emperor, was passing through Cologne and sought shelter in the Dominican cloister where Albertus lived. The country through which the king had just passed en route was inanimate and silent as one would expect in deep winter, but it was his profound astonishment and amazement to find Albertus in a beautiful garden filled with plants and shrubs, some of these in full bloom and with some of the trees bearing fruit. The air was filled with a fragrance of blossoms. Here, in the center of the garden, a sumptuous banquet was served to the king. As soon, however, as the royal cortège had left the neighborhood, all these things disappeared and there was again only the silence of winter. So, of course, Albertus must be a magician who had produced all this out of thin air in order to impress the travelling monarch favorably.

A more materialistic explanation of the same episode would have been that Albertus, being one of the foremost botanists of the world, had probably one of the largest conservatories in all of Europe in the gardens of the monastery. Thus could easily be explained the summer temperature in the midst of winter, and also the blooming shrubs and blossoms. Such a simple event easily explained by rational reasoning can take on an entirely different interpretation when one seeks the marvelous or miraculous and is superstitiously inclined.

One cannot find, however, a single word in all of his writings nor in any of the accounts of his life which would justify calling him a magician.

Without a doubt, in spite of his great fund of knowledge and his genius, Albertus was a victim, along with his scientific contemporaries, of the errors of his time. However, one should not judge men of science of those times by the errors which they committed, but should think only of the exact facts which they added to the fund of knowledge which already existed.

Albertus' greatest literary effort was the "Opera Omnis" which consisted of twenty-one volumes. It has been said in criticism that it would have been physically impossible for one human being to have produced such a huge amount of original work in spite of the fact that Albertus was known as a prodigious worker. It must be kept in mind that his manuscripts were not translated and arranged for printing until 400 years after their creation and that much was undoubtedly added by others not quite so competent. Therefore, many errors cannot be legitimately attributed to his authorship. When one gazes at the vast number of works attributed to Albertus, one cannot help but think that possibly the criticism and questioning of authorship may be just. How could one individual compile so much, considering the amount of research necessary for such a work and the time consumed in the collection and compilation of the material before the manuscript could ever have been written? There is, obviously, ample ground for doubt.

Perhaps an explanation might be that the bulk of his work was done by collaborators and students under his direction, with the finished product carrying only his name.

Albertus was born in the year 1193. His family name was Bollstadt, borne at the time by a very rich and powerful family in Germany. To have been born rich was fortunate in his particular case because he was able to command the necessary funds for his extensive travels within and without his own country in later years, and to accumulate the large collection of specimens, etc. which he needed in his studies.

It has been said that in his early youth his intelligence was poor and his learning very slow. As a young man, however, his knowledge and intelligence astounded all of

his teachers. It is amusing to read in the biographies of Albertus Magnus, Thomas Aquinas and Duns Scotus, three of the greatest minds of the thirteenth century that they were accused of stupidity and a colossal lack of intelligence in their early studies. Thomas Aquinas was called "The Dumb Ox" and our present day word "dunce" owes it's derivation way back in time to a "transposition" of Scotus' first name "Duns."

With reference to Albertus' youth and studies, another superstition exists: It is told that on one occasion when he was very melancholic and in deep despair, considering whether or not the wisest move for him was to renounce the religious cloister and all efforts at serious study, the Holy Virgin, touched by his piety, appeared before him in all of her glory, to arouse him from the depths of despair into which he had plunged.

Fig. 1. A scarce print of Albertus Magnus.

"In which branch of science," said the apparition, "Would you prefer to excel—theology or philosophy?" Albertus chose without hesitation, philosophy. At the same instant, so the story goes, the Virgin endowed him with the gift of genius, replying, "You shall be one of the most distinguished men of science. But as you have preferred the profane theories of materialism in place of the beauty of divine science, in punishment for your choice you will one day return to that same stupidity and

despair from which I have lifted you." And with that the vision disappeared.

It is not impossible that Albertus in his youth, his entire spirit being imbued with the passion for study and with deep religious fervor, possessed also by a deep desire to make a place for himself in the world of science amid the celebrities of his time, might not have had a dream such as described above and related it to some of his associates. As the origin of the story is attributed to Fra Bartolomei, his confessor and superior in the Dominican Order, it might serve as a simple explanation for such a superstition. Prophetic dreams are not rare in the lives of great men or men of genius.

Be that as it may, the first part of the prediction was not late in being accomplished. Albertus immediately began to astonish his teachers and superiors by his comprehensive knowledge and later became one of the most celebrated men of science of his century. It is related that the second part of the superstitious legend also came to pass. At the age of 80, just three years prior to his death, he was seated in his chair in Cologne giving a lecture to his students when suddenly he became speechless and fell over on his side as if struck by some object. From that time on he was confined to bed, his mental faculties lost, and continued speechless. Of course, if one wishes to take away the superstition from this story, one more materially minded would say that Albertus had suffered a cerebral hemorrhage to which he could most certainly be susceptible at the age of

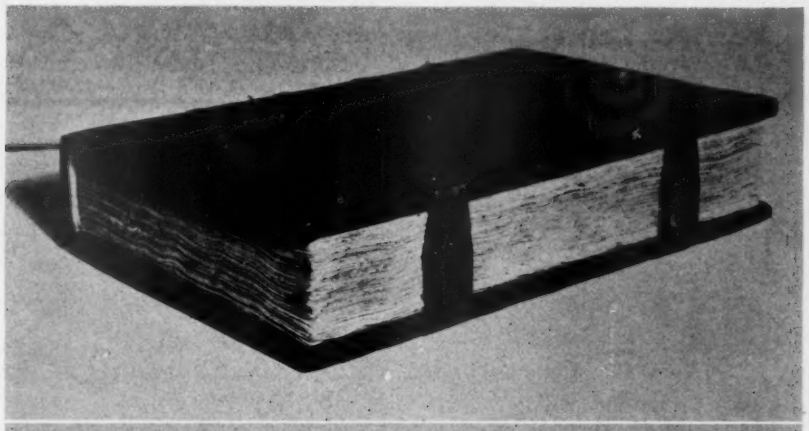

Fig. 2.

Fig. 3.

Fig. 2. A copy of "Sermones de Tempore" by Albertus Magnus. Printed by Johann Wiener in Augsburg in 1476. This illustrates a magnificent specimen of leather bookbinding of the period and 350 years later in an excellent state of preservation.

Fig. 3. The same as Figure 2 showing the book open. This is illustrative of the highest attainment of the art of printing at that time.

80. That would give the same clinical picture, *i.e.*, toppling over from a "stroke."

On this occasion Albertus immediately recalled the dream of his youth and felt that the second part of the prophecy had come to pass, that the most important part of his life, his intelligence, had been taken from him. It gave rise to a saying among the elders, "Albert the Great, who was changed from an ass into a philosopher, was afterward changed from a philosopher into an ass."

To return, however, to his life as a student. Having demonstrated his capacity to absorb knowledge, he was sent to visit the principal schools in the centers of learning of Germany, Italy, and France. It was in Padua that he seriously commenced the study of philosophy, medicine and mathematics. In that city he became associated with the superior general of the Dominican order, Father Jordan, a most learned and influential man. This association had considerable influence upon his future destiny.

It was the custom and practice of the Dominican fathers to recruit to their ranks the sons of families of prominence and fortune who gave promise of intellectual attainment. Albertus, of course, had all of the necessary qualifications, birth, fortune, family, character, intelligence and imagination. It was only natural therefore that through the influence of Father Jordan he should become a member of the Dominican order.

During the Middle Ages, Europe was a hotbed of civil and state wars, and the people in general were in a constant state of oppression either from one captor or another, so that for one who was studiously inclined life in a monastery had its compensations. It was quite, free from outside intervention and held by all warring factions to be inviolate. It is supposed by his biographers that he entered the Dominican order either in 1222 or 1223, the exact date being uncertain.

Following the completion of his studies at Padua, Albertus was sent to Cologne in Germany, where the principal school of the Dominiçan order was located. Those who were selected for this school were expected to show exceptional capability and to take their places later among the leading orators and teachers of the day. This was not an easy task as the difficulties to be overcome in attaining to this rank were considerable. It was necessary that one should above all be of superior intelligence, a true lover and student of science, with a desire to communicate this to others by teaching, a strong character and above everything in absolute obedience to the strict discipline of the order. These qualities were, of course, all present in Albert von Bollstadt.

Albertus began his career in Cologne as a lecturer in natural science and religious science, the two subjects which were most in the minds of all students of the century. His lectures were extraordinarily successful. There had never been in the order anyone who so ably interpreted and expounded the theological and scientific dogmas of the day with such clarity and force.

It was to the best interests of the Dominicans, and for the purpose of furthering the prestige of the order, that Albertus should deliver these same lectures in the great centers of population. So he was then sent to such large university seats of learning as Fribourg, Ratisbone, and Hildesheim. In all of these and others he was preceded by a fame which was mounting each day. These lecture tours were a grand succession of triumphs for Albertus. By the end of the year 1240, having completed his "Grand Tour" as it was designated he was recalled to Cologne.

During all the while that he made these lecture tours, however, he was constantly adding to his fund of knowledge by study. Travel in his day was on foot, but instead of taking the more well known roads, he took the little known byways which gave him an opportunity to pick up specimens, stones, plants, roots, shrubs, etc. At the same time he visited all of the libraries in the convents and monasteries along his route, collecting literary material. In this manner he discovered many old hidden manuscripts

which were considered lost. He copied, translated and had them arranged by some of his junior assistants in the order who often accompanied him and helped him in his researches. In this manner he collected the vast amount of material he used in many of his later books.

The effect of getting off into lonely isolated pathways and highways must have been an inspiration to a man possessed of a vivid imagination and a speculative mind. To the great philosophic minds of history solitude has been the necessary adjunct of contemplative thinking. To see nature at different times of the day, different seasons of the year and its effect on all living things, the elements under different conditions, etc., could not help but stir such an individual to deep thought as to the why therefor. It was probably of incalculable value in helping him to evaluate between positive science and theology and thus be able to expound it so clearly. He was the first of the philosophers to demonstrate that the one could be accepted without refutation of the other. This, of course, made him even more popular, so that from all countries scholars came to Cologne to attend his lectures. In view of the fact that the Church was distinctly against the tenets of positive science, this was no small labor.

In 1245 the head of the Dominican order decided that Albertus should be sent to Paris in order to receive his diploma as Master of Science. Only the University of Paris was empowered to confer this degree, and it was necessary to attend the courses for three years before it could be obtained. Here the true measure of one's intellectual ability was severely tested because the teaching usually consisted of open debate before a large and distinguished audience of scholars and men of science. The University of Paris during the time of Albertus was considered the most brilliant scholastic faculty, and its instructors were equally brilliant and renowned.

There was at this time at the University of Paris considerable discord, particularly among the faculty. Up to about 1200 there had been only two divisions in the University, professors who taught, and students who learned. However, a few priests had been admitted to the teaching faculty by royal decree. They were unable to adapt themselves to the general scheme of things because of their individual fixed ideas, and the faculty was therefore kept in a constant state of embroilment. The result was that there was a division of faculty and students according to belief, into three distinct groups, one a school of theology which was dominated by the fathers, the other a school of laws, dominated by the group most interested in law, and a third group constituting a school of medicine. This inability on the part of the fathers to adapt themselves to the general scheme of things as they existed led to the formation of the first real and distinctly separate medical school. It constituted the first time that a definite line of cleavage had been drawn between medicine and philosophy. From the standpoint of medicine as a science, and also from the standpoint of medical history, this was an event of utmost importance.

Paris at that time was almost entirely a city of students, principally because of the fame of its university. The students composed a collective body so much larger than the farm or laboring city class that they demanded extraordinary privileges for themselves, such as immunity to arrest unless for very grave crime, etc., on the threat of moving elsewhere. This, of course, would have meant ruin for every shopkeeper and workman in Paris. The extraordinary privileges were accordingly granted. The activity of pressure groups is therefore not a phenomenon restricted to the present day.

The church itself was also in a period of uncertainty because of the efforts of the intellectual minds to merge philosophy with theology. This became so troublesome that the church threatened with excommunication any and all who expounded or believed in the philosophy of Aristotle.

It was in the heat of this ecclesiastical and intellectual turmoil that Albertus arrived in Paris, accompanied by his pupil and friend Thomas Aquinas, the Thomas Aquinas who was to be the beacon light of learning of the thirteenth century.

Albertus was immediately successful in everything he did. His system of discussing, reasoning and solving problems made such an instantaneous success that students came to Paris from every part of Europe. The university halls were not large enough to accommodate them and it was necessary for Albertus to conduct his classes in the open air, in a public square adjacent to the University. This acquired the name "Place de Maître Albert" or Place Menbert in more recent times. There still exists on the wall of an old building in which there is today a pharmacy, parts of a fresco showing Albertus surrounded by his students, all in the costumes of the Middle Ages, listening to the Master.

The foundation of Albertus' lectures was the science of the earliest Greek times as typified by the manuscripts preserved by Aristotle for the generations to follow and made available through his own writings. The lectures consisted of a collection of observed facts, studied and coördinated according to the reasoning and scientific investigation of the Greek minds of Aristotle's time, made to fit the needs of the Middle Ages and its intellectuals by Albertus.

It had been difficult therefore to separate true scientific thought from the highly speculative metaphysical. Albertus, however, did this so well that the minds of his pupils were hypnotized by his imagination, his ideas and his knowledge. They did not wish to hear any other lecturer, but waited breathlessly for the last word in science from this Dominican who had so fired their imagination. He was regarded almost as a supreme being from whom no secret of earth or sky was hidden.

Two of his pupils at these lectures were later to carry on and become as famous as the Master himself, Roger Bacon and Thomas Aquinas. Another name which was to become most famous in the field of chemistry and medicine later, was Arnold of Villanova, also a pupil at this time.

In 1248 Albertus was recalled to Cologne and left Paris once again, accompanied by his pupil, Thomas Aquinas. At Cologne he was named Regent of the Dominican College.

From then on, the path of students of science and philosophy from all of the then known world led to Cologne, so that the "Master" was again compelled to lecture in an open square to accommodate the large number of students who came to hear him.

In 1254, during a conclave at Worms in Germany, Albertus was raised to the ultra-dignified status of a Provincial in the order. This meant that he was in charge of the administration of one province of the Dominican order, consisting of Austria, Bavaria, Saxony, Alsace and Holland.

Albertus began to comply with the duties involved by visiting on foot the entire province in his charge. Since he was extremely simple in his needs and in everything he did, it was perhaps difficult to reconcile such a modest, unassuming appearing person with the great mind known throughout all Europe. But as proof of his sincerity in his beliefs and mission in life, neither honors from the Pope himself, nor from great kings or princes could persuade him to leave Cologne for some other city, other than for a temporary visit.

He journeyed to Rome for the purpose of conducting some important theological conferences under the patronage of Pope Alexander IV, but did not remain long and returned again to Cologne. In 1255 he once more visited Rome, this time accompanied by his pupil, Thomas Aquinas, in order to defend before the Pope certain privileges which were held by the Dominicans and which were in danger of being taken away.

In 1259 he resigned his office as Provincial in the order that he might have more time for study, but the Pope, not wishing to lose from the Church such a glorious

name, named him Bishop of Ratisbone. This post carried with it the highest degree of social prestige and dignity and was a position of real authority. He became extremely popular in his rich diocese because of his simplicity and his endless charity, but he was unhappy and much preferred his simple cell in the monastery in Cologne to the magnificent palace in which he lived as Bishop of Ratisbone. His unhappiness increased to the point where at the end of three years he asked to be relieved of his duties and to relinquish his title as a Prince of the Church. This was granted and he returned to Cologne, where he was again happy to be a simple monk and to have the opportunity of study.

The life of a monk and of study was to be short-lived as word had been spread throughout Europe of the persecution and horrible massacre of countless Christians in Asia. Albertus received orders from the Pope, Clement IV, to conduct a preaching crusade throughout Germany and Bohemia in behalf of Christianity.

Having accomplished this mission, he again returned to Cologne, but was almost immediately ordered away again, this time to take part in the celebrated Council of Lyons. On this mission he departed in a much happier frame of mind, inasmuch as he hoped to meet at this Council his friend and former pupil Thomas Aquinas. This was not to take place, as the Angelic Doctor died on the way to the conference in a small, out of the way abbey in France. Thomas' death caused him profound grief and grave disappointment, and it was noted at the conference that his enthusiasm and energies were much dampened.

After the conference, Albertus returned to Cologne and took up his lecturing again, but a short time afterward he was striken with apoplexy and was never again able to appear before his students. His mind became completely a blank. He was able only to visit every day the plot he selected for his grave. He lived for three years after his stroke, unable to think, unable to speak, life a complete blank.

Having briefly described his life which as one can see was completely and fully occupied up to his mental and intellectual death, how can one account for the completion of twenty-one immense volumes of research transcribed laboriously on parchment, in addition to the voluminous amount of other work which is attributed to him.

To anyone who has any conception of the amount of labor involved in assembling the necessary material for a scientific or historical work, say for example an octavo edition of 700–800 pages, it can readily be seen that one man alone could not possibly have written twenty-one such volumes as those of Albertus Magnus, even if he had spent his entire lifetime only in writing. Then when one considers the time he consumed in lecturing, in preparing these lectures, in traveling, in directing his province as Provincial, later his diocese as Bishop, it can be seen that it was not humanly possible for him to have accomplished such an opus alone. Therefore a great many of the works attributed to him were probably the work of assistants or collaborators, but he was, possibly, the guiding or directing genius.

A French scientist, Pouchet, has written an entire book to show that all of the science of the Middle Ages began with Albert the Great. A science, however, cannot be conceived as the work of one man. It consists of the piling up of a series of observations, based upon experiments; although one man may contribute much, it can never be said that he contributes all.

Perhaps Albertus' one outstanding contribution to the world was his work in bringing together the theology of the church and natural science. This he did by demonstrating the greatness and the power of a supreme artist, a supreme scientist, as manifested by the everyday observations of nature around us.

It is true perhaps that many of the doctrines and theories he expounded had existed prior to him, that he had found them in the manuscripts hidden in the old

monasteries and libraries which he visited. Many ideas were not original with him, but merely translations from the Greek. After all, however, it was his diligence in uncovering them which made them available for future generations—and for that we owe him a profound debt of gratitude.

It is also felt that much of what he gathered, translated, and compiled still exists today, unknown to present day scholars, in the great Spanish, Egyptian and Turkish libraries. Some day perhaps it also will be brought to light and then the genius of the man will be even more fully understood.

It was not difficult, of course, for him to uncover a vast amount of material, because his social position and his powerful position in the Dominican order gave him access to the libraries of a large number of monasteries, to the great collection of manuscripts in these monasteries, and also to the enormous collections of the Popes.

As an illustration, not long ago in Bohemia, there was unearthed a library of manuscripts that had not seen the light of day, according to authoritative estimation, for more than five hundred years. It was the buried underground crypt of a monastery, where scribes probably worked, and among these manuscripts were several attributed to Albertus.

There were also hundreds of the humbler members of his order whom he could call upon as assistants to translate these manuscripts from the original Arabic, Greek or Oriental languages and to classify and catalog the acquired documents.

It has often been stated by his critics that none of his works was original with himself, that for everything which he wrote or which was credited to his authorship, an original manuscript can be checked in some ancient library. He merely had access to the manuscript, assigned a monk to translate it, then passed it on as his own. Much of his medical work, particularly his vast encyclopedia, consists merely of recapitulating the work of Avicenna, who had translated into the Arabian the works of Galen and Aristotle. Albertus translated it, or more probably had it translated, into Latin, and it then appeared as his work. Avicenna had added some commentaries of his own and Albert also added here and there a notation of his own. The works of Avicenna were, of course, the scientific authority on natural history, physics, chemistry and medicine during the Middle Ages and were the basic work used at the great schools of medicine in Europe, that of Salerno and also that of Montpellier.

It is assumed that these collaborators with Albertus had access to a large number of Arabian manuscripts, such as those of Rhazes, a contemporary of Avicenna and also those of Averroes and many others of less renown.

His twenty-one huge volumes or "Opera Magna" can, therefore, be considered not as an original work, but as a résumé of all that his satellites had collected and translated. This material was used by him over a period of forty years or more in lectures in various centers of learning, then gathered together under his editorship, as in the modern manner.

It is curious also to the bibliophile that the arrangement of his work follows almost step by step that of Aristotle, although it is definitely known that Albertus did not use the Greek text of Aristotle but rather the Arabian of Avicenna. Aristotle devotes his first eight books to physics, and so in like manner does Albertus.

He treats in these eight books of the study of natural forces, the earth and sky, the laws of generation of living things, and of the phenomena accompanying death with decomposition of the body. One of these books, however, "De Natura Vocorum" differs widely from Aristotle according to authorities. The views therein are his own original observations. It is here he first represents the earth as round, 250 years before Columbus became obsessed with the idea.

He also devotes an entire chapter (which is his own original work) in an explanation of the origin of meteors. Another chapter

is devoted to an explanation of thermal springs, of the hot waters present in them, and of their use in the treatment of disease.

He observes that he believes that in the time of Aristotle an instrument was known which would guide ships over the seas, in the manner of our modern compass. However, there exists authority that the Phoenicians long before the Christian era used an instrument of navigation and prior to them the Chinese also used such an instrument.

His "De Coele et Mundo" and his "De Generatione et Corruptione" came after the work in physics, then the book on "Meteores" and then "De Mineralibus." The work on minerals is believed to be entirely the elaboration of his own original observations. He describes in alphabetical order all the minerals which he knew. Nothing is described of which he did not have actual personal knowledge.

His book, "De Animalibus" is considered his best work, most scholarly and the most instructive. Authorities claim that they can see in the style of writing and the arrangement of facts large borrowings from the writings of Aristotle; they state, in fact, that it is merely a copying of Aristotle's work with some additions and commentaries of his own. Others claim that in the section devoted to "Anatomy" he completely changes the descriptions of Aristotle, and that his description is more intelligible, more complete and more remarkable. In this he followed a new plan of his own and a definite order. First he described the vertebral column, then the thorax, then a complete osteology with a careful minute description of the bones. Next in order he described muscles in general, then more minutely the muscles of the head, then next a description of the anatomy of the nervous system, with a detailed description of the cranial nerves, and a description of their origin and distribution.

Then follows a description of the circulatory system which is supposed to be more detailed and even more complete than that of Aristotle.

The work ends with a description of the phenomena of generation in animals and by almost a word for word translation of the physiology of Aristotle.

There are then six works devoted to "Physiognomy" similar to that of Aristotle, plus additions from the work of Theophrastus on "character." It seems that Albertus was the first to call attention to the idea of determining certain human characteristics by an examination of the protuberances of the skull, the earliest mention of the science of phrenology.

It is felt by many close students of his writings that wherever he deviates from the writing of Aristotle, he falls into the style of the old Arabian men of science, to whose manuscripts he had access.

His twenty-first volume is an endeavor to assign to man his relative place in the general scheme of things as related to other things around him. This constituted the correlation of natural science with theology.

His twenty-second volume is a natural history of all the animals known in Europe, a zoölogy. In this work he was able to add to the knowledge gained by Aristotle and Pliny in that he described animals of the polar region, of which they had no way of gaining knowledge. He also described whales and the methods used in their capture, which was entirely new, never mentioned before. Whether Albertus ever journeyed to the polar region is debatable. He may have traveled sufficiently far north on the coast to have acquired personal knowledge of all this, or perhaps he obtained information from native inhabitants.

His twenty-third volume was devoted to birds, describing in detail all species known to him, their habits, diseases, method of treatment, etc. Also a large section devoted to falconry, methods of training falcons, etc.

His twenty-fourth volume is devoted to animals living in the sea, the twenty-fifth to serpents and reptiles, then the "De Parvis Animalibus Sanguinem non Habentibus" of "small animals which have no blood," insects, and like.

A botanical treatise, "De Vegetabilibus et Plantis," although of only 160 manuscript pages, is considered a monumental work, because his own observation was so keen and critical and he described the anatomy and physiology of plants so thoroughly that to the present day little change has been made in the description of those specimens to which he had access.

All of these writings were part of a definite plan; this encyclopedia of knowledge, embracing all of the sciences of his day, was an idea born from the study of Aristotle. The idea was not merely to bring it up to date, but with Albertus there was an additional purpose, to throw light upon natural laws and the miracles of nature. His aim was to supply a basis for a theology and to show the relation between man and God. He was truly the Aristotle of the Middle Ages.

Albertus the Great was buried in a small church in Cologne, St. Andrew's, hidden away, with no monument and no epitaph, in simplicity such as that in which he had lived.

To list some of his contributions which are more or less undisputed by his critics one would name the following:

In his "De Mineralibus" he first hinted at the use of minerals in the treatment of disease. He first made use of the word "amalgam," a compound of mercury, although sometimes credit for this is given to his pupil, Thomas Aquinas. He was the first to describe the magnet properties of lodestone and enumerated different metals having magnet properties with a full description of each.

In his "Liber Cosmographicus de Natura Locorum" he first called attention to the influence of latitude and longitude on temperature and the influence of the degree of angle of the sun rays in heating the ground.

In his "De Coelo et Mundo" he first described the Milky Way as being a vast collection of stars.

In his "Physica" he first described the power of refraction of certain crystals and mentions mirrors.

In his "De Vegetabilibus et Plantis" he described the sleep of plants, the periodical opening and closing of blossoms, the diminution of sap through evaporation from the cuticle of leaves and the influence of the distribution of the bundles of circulatory vessels on the folial indentations. At the end of this particular book he says: "All that is here written is the result of our own experience or has been borrowed from authors whom we know to have written only what their personal experience has confirmed, for in such matters only experience can give certainty."

To Albertus Magnus, therefore, is medical science indeed indebted.

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APRIL TO JUNE

1944

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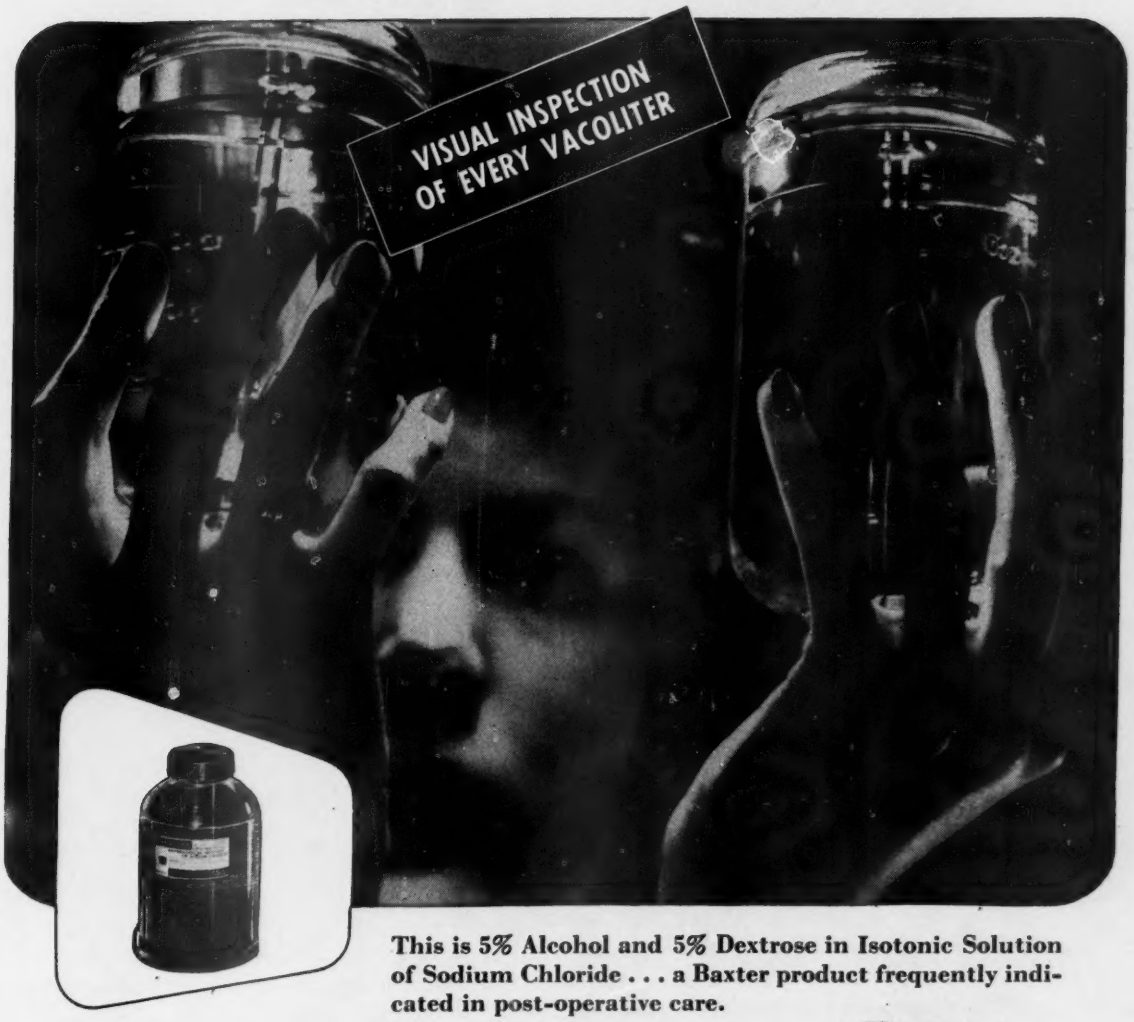


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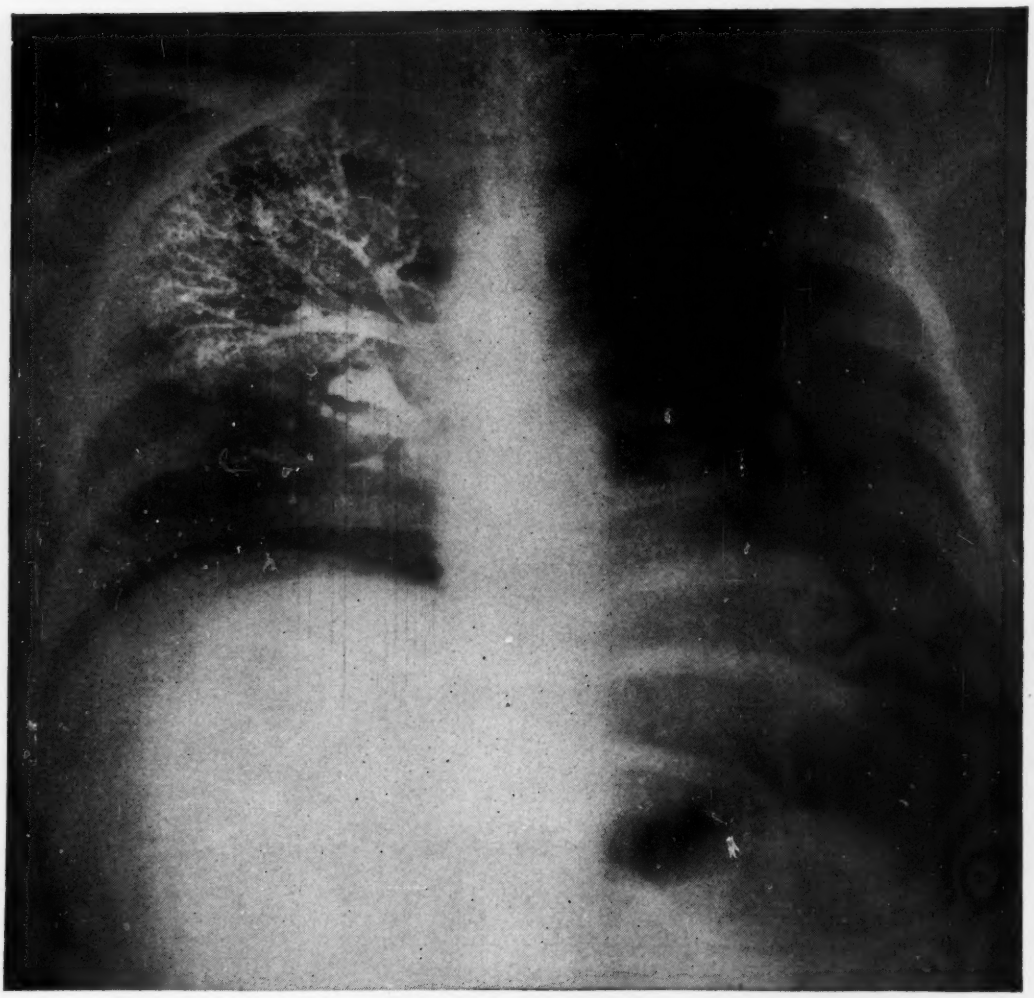

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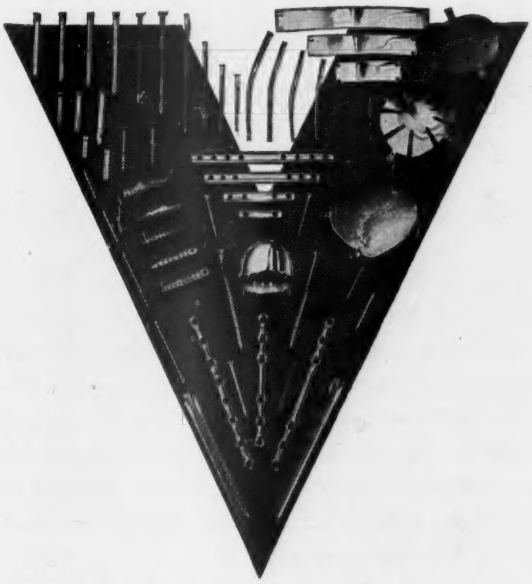

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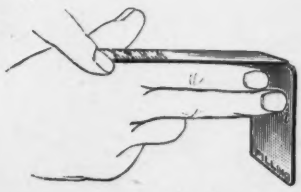

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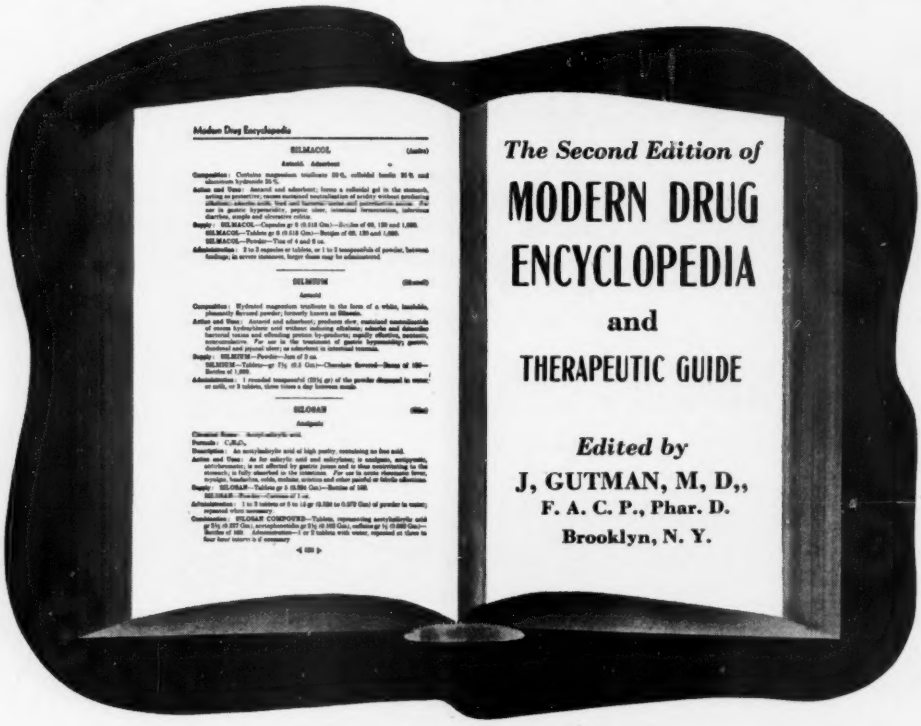


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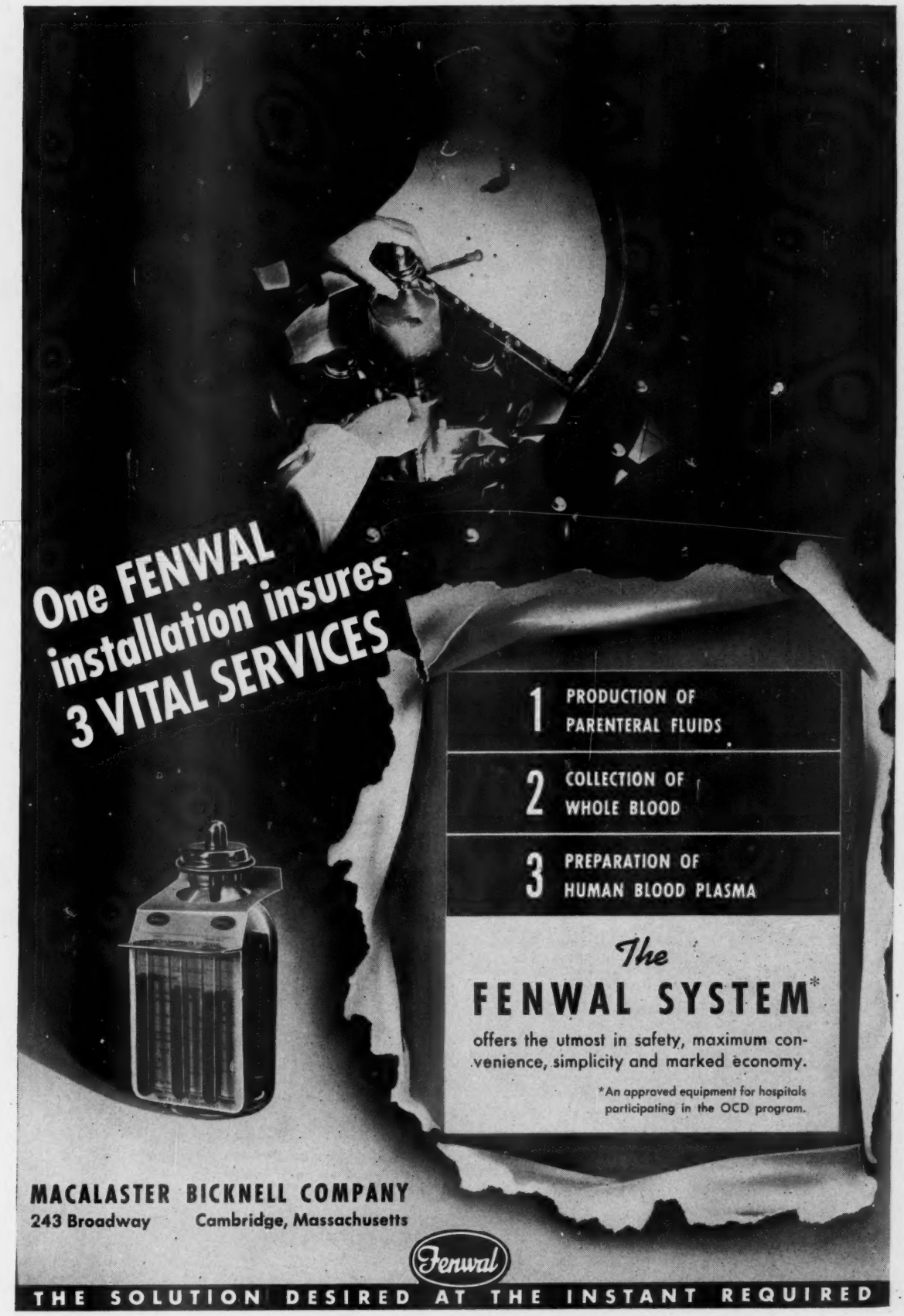
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**1940**—Merck research on antibiotics concentrated on Penicillin.

**1941**—First report of Penicillin's clinical value.

**1941**—Prof. H. W. Florey and Dr. N. G. Heatley, of the Oxford group, visited the United States to confer with interested Government officials and manufacturers, with the objective of establishing Penicillin production in America.

**1941**—Dr. Heatley, who participated in the first production work in England, remained at the Merck Research Laboratories to collaborate with Merck chemists in developing test and production procedures.

**1941**—Merck brought about a reciprocal arrangement between British and American investigators to spur production in cooperation with the United States and British governments.

**1942**—Merck supplied Penicillin for first case of bacteriemia successfully treated with Penicillin in America.

**1942**—Merck Penicillin was rushed under police escort to Boston for treatment of the Cocoanut Grove fire casualties.

**1943**—Merck sent supplies of Penicillin to England by air transport for urgent therapeutic use by the United States Army Medical Corps.

**1943**—Large-scale production of Penicillin was established by Merck to meet Government requirements.

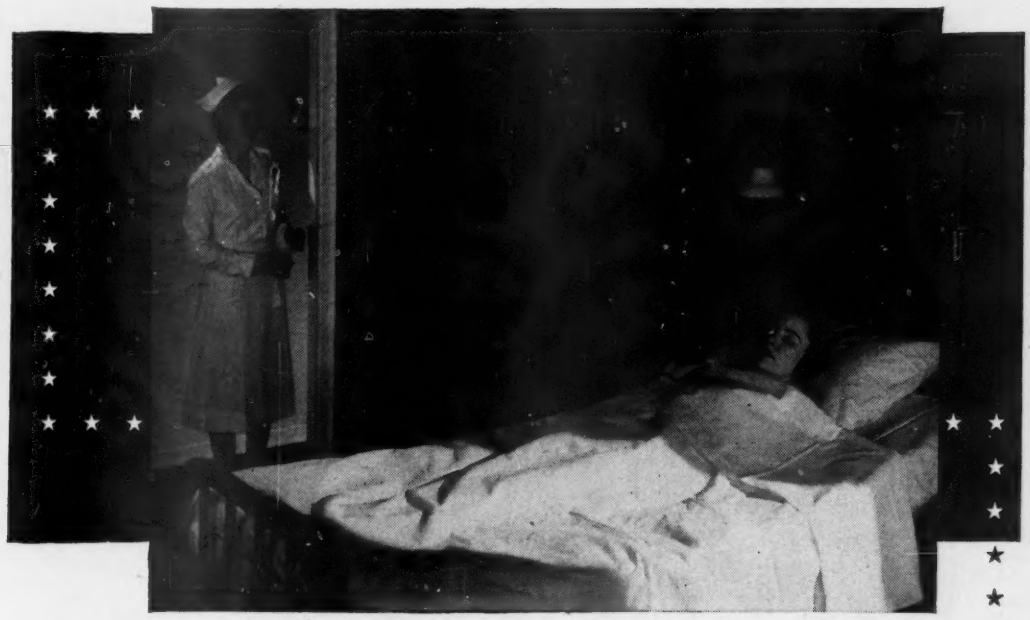
**1944**—Merck sends ever-increasing supplies of Penicillin to our Armed Forces.

*Merck & Co., Inc. will continue to surpass present production records, with the urgent objective of supplying adequate quantities of Penicillin for civilian use, as soon as the essential requirements of our Armed Forces have been fulfilled.*

MERCK & CO., Inc. *Manufacturing Chemists* RAHWAY, N. J.

In Canada: Merck & Co., Ltd., Montreal and Toronto

***An illustrated booklet describing the clinical uses of Penicillin Merck is available on request.***



# *Sleep* AIDS CONVALESCENCE

**The jumpy, jittery patient hasn't quite the same opportunity for a smooth convalescence as the one who receives the benefit of a full night's restful sleep.**

**Because of the low toxicity of Butisol Sodium, this proven sedative is useful in both pre-operative and post-operative management.**

## BUTISOL SODIUM

**(Sodium salt of 5-ethyl-5-secondary butyl barbituric acid "McNeil")**

**A Potent, Well-Tolerated Sedative**

***Indications:*** **Insomnia, pre- and post-operative sedation, neuroses, obstetrical hypnosis.**

**Butisol Sodium is supplied in capsules containing one and one-half grains. Bottles of 100, 500 and 1,000.**

***Trial supply on request.***

McNeil Laboratories
INCORPORATED
PHILADELPHIA • PENNSYLVANIA

# *Low Tissue-Toxicity*

## YET POWERFULLY GERMICIDAL

Phe-Mer-Nite Tincture and Phe-Mer-Nite Solution combine high bactericidal power with notably low tissue toxicity. In preoperative skin preparation, the Tincture (1:3000 alcohol-acetone-aqueous solution) produces dependable skin sterility within 3 minutes; soap and water readily remove the residual color. Since Phe-Mer-Nite Solution (1:1000) retains its germicidal potency in the presence of blood serum, it finds many uses in everyday practice, in the hospital, and in industrial plants.

# PHE-MER-NITE

(Brand of Phenylmercuric Nitrate)

Virtually nontoxic. Does not precipitate tissue proteins. Diluted 1:4 (water) the Solution sterilizes instruments and rubber gloves harmlessly in 5 minutes. This Solution may be applied to burns and other lesions requiring antisepsis. Phe-Mer-Nite Tincture and Solution are supplied in gallon and pint bottles. Surgeons are invited to send for literature and liberal clinical test samples.

**THE S. E. MASSENGILL COMPANY**
**Bristol, Tenn.-Va.**

NEW YORK • SAN FRANCISCO • KANSAS CITY SEMCO

# Crystals should be seen

## ...not heard from

Crystals often possess great beauty, but in delicate renal tubules they can be as damaging as powdered glass, as obstructive as hydrargyrism.

During sulfonamide therapy the dangers of crystalluria may be effectively diminished by administration of 'Alka-Zane'* Alkaline Effervescent Compound which raises urinary pH and thereby helps bring sulfonamides safely through the kidney, in solution. Sulfonamides may be ten times more soluble in alkaline urine than in acid urine.

'Alka-Zane' Alkaline Effervescent Compound makes a refreshing, effervescent drink, increases sulfonamide solubility and fluid intake, and provides calcium glycerophosphate, magnesium phosphate, calcium phosphate, potassium bicarbonate, sodium bicarbonate and sodium citrate. . . . William R. Warner & Co., Inc., 113 West 18th Street, New York 11, N. Y.

*Trademark Reg. U. S. Pat. Off.

'Alka-Zane'

*alkaline effervescent compound*

OMNIS ORBIS
WARNER
ESTABLISHED 1856

# In Postoperative "Habit" Restoration

The early resumption of normal bowel function after surgery is an important factor toward uneventful recovery. Hence it is of moment that early postoperative feedings do not prove a hindrance in this regard.

Cereal breakfast foods such as corn flakes, corn cereals, farina, oat cereals, oatmeal, puffed cereals, rice cereals, wheat cereals and wheat flakes usually are the first solid foods permitted, not only because of their notable contribution of many essential nutrients, but also and mainly because of their easy digestibility and their effect on intestinal peristalsis.

Each ounce of such cereals (wholegrain, enriched, or restored to wholegrain values of thiamine, niacin, and iron), served with 4 ounces of whole milk and 1 teaspoonful of sugar, provides the following average amounts of nutritional essentials:

| | |
|---|---|
| **Calories** | **205** |
| **Protein** | **7.00 Gm.** |
| **Carbohydrate** | **33.00 Gm.** |
| **Fat** | **5.00 Gm.** |
| **Thiamine** | **0.18 mg.** |
| **Riboflavin** | **0.30 mg.** |
| **Niacin** | **0.84 mg.** |
| **Calcium** | **0.16 Gm.** |
| **Iron** | **1.29 mg.** |

The contained thiamine exerts a stimulant influence upon intestinal peristalsis which is further enhanced by the cholagogue action of the well-emulsified fat in this palatable dish.

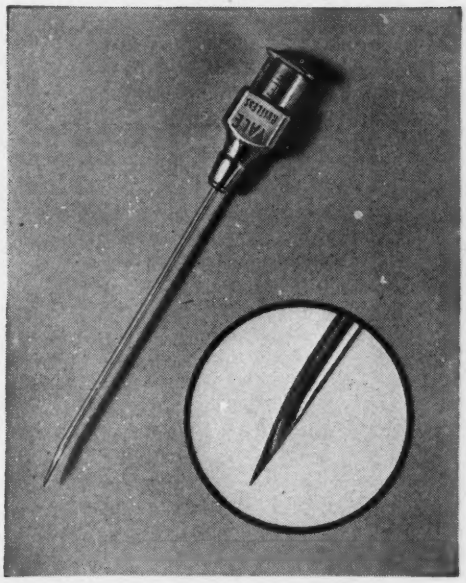
*The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.*

CEREAL INSTITUTE, INC.
135 SOUTH LA SALLE STREET • CHICAGO 3

# *The* HUBER POINT

## *A Major Advance in Hypodermic Needle Point Design*

### *—available on YALE-LOK needles!*



It has long been recognized that the ideal hypodermic needle point should:

1. Penetrate tissue easily with a minimum of pain.
2. Make a clean slit or cut on insertion — without gouging.
3. Minimize seepage when needle is withdrawn.

It is apparent, however, that with the bore opening at the end of the cannula, gouging, resultant pain and seepage can never be efficiently controlled.

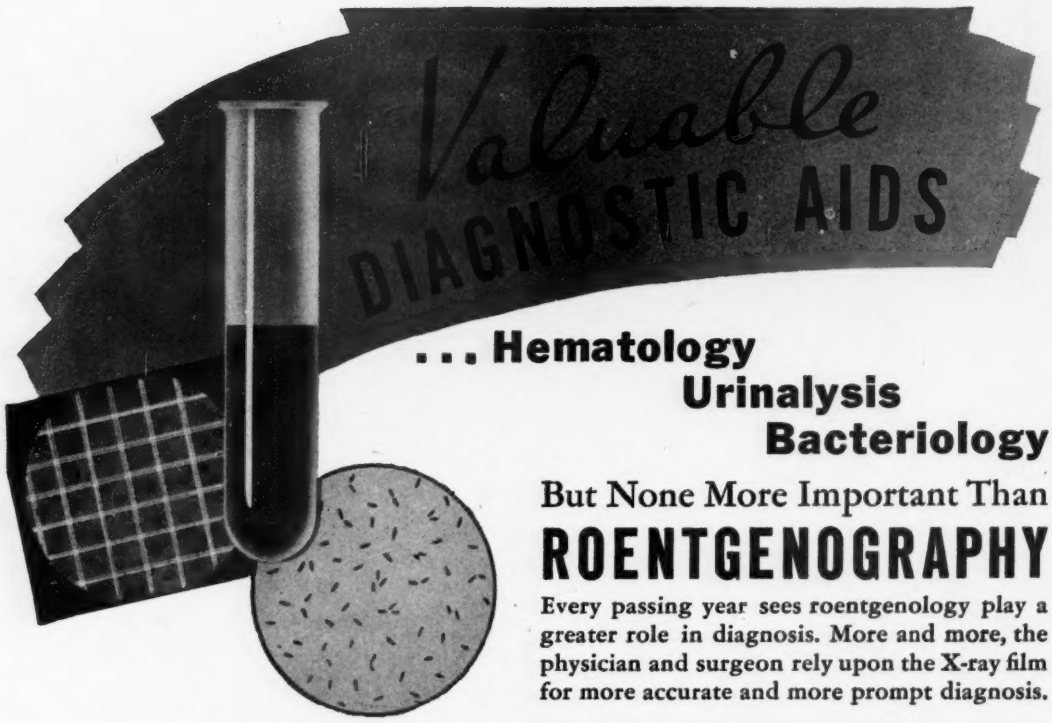
Therefore, Huber Point Needles have the bore opening at the side where it is not in position to catch or punch out tissue plugs. The sharp point simply divides the tissue. The closed bevel enlarges the initial slit, which contracts when the needle is withdrawn.

Result: A minimum of trauma, pain and seepage.

Specify Yale-Lok Needles with or without the Huber Point. The price is the same. Your regular dealer can supply you.

B-D PRODUCTS
*Made for the Profession*

**BECTON, DICKINSON & CO., RUTHERFORD, N. J.**




**. . . Hematology**
**Urinalysis**
**Bacteriology**

But None More Important Than

# ROENTGENOGRAPHY

**Every passing year sees roentgenology play a greater role in diagnosis. More and more, the physician and surgeon rely upon the X-ray film for more accurate and more prompt diagnosis.**

*For Sharper Diagnostic Roentgenography*

# MALLINCKRODT CONTRAST MEDIA

**BARIUM SULFATE U. S. P. XII** for X-ray Diagnosis—made by an exclusive Mallinckrodt precipitation process for utmost smoothness, excellent suspension, and freedom from injurious foreign substances.

**HIPPURAN* N. N. R.** (Sodium Orthoiodohippurate)—Non-irritating and relatively non-toxic for pyelography, cystography and urography.

**HIPPURAN* STERILE SOLUTION N. N. R.** (12 grams of Hippuran* dissolved in 25 cc. distilled water)—Literature references as to recommended technic, indications and contraindications sent on request.

**IODEIKON*** (Iodophthalein Sodium U.S.P. XII)—Proposed by Dr. E. A. Graham and his associates and introduced by Mallinckrodt to the medical profession as an X-ray medium for the visualization of the gallbladder.

**ISO-IODEIKON*** (Phentetiothalein Sodium N.N.R.)—This isomer of Iodeikon, developed by Dr. E. A. Graham and his associates in collaboration with Mallinckrodt research chemists, was first introduced by Mallinckrodt Chemical Works. This excellent X-ray medium permits the examination of the gallbladder and the measurement of the hepatic function from a single injection of the dye.

*Trade Mark Reg. U. S. Pat. Off. Hippuran U. S. Pat. No. 2,135,474.

*Information and Literature at Your Request*

FINE CHEMICALS Mallinckrodt SINCE 1867

**MALLINCKRODT CHEMICAL WORKS**

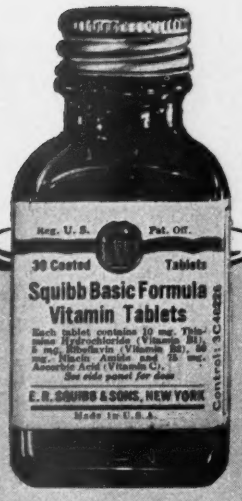
*77 Years of Service to Chemical Users*

**Mallinckrodt Street, St. Louis 7, Mo. • 74 Gold St., New York 8, N. Y.**
**CHICAGO • PHILADELPHIA • LOS ANGELES • MONTREAL**

# Basically Sound

THE prompt restoration of health in individuals suffering from deficiency of the water-soluble vitamins is facilitated by the following measures:

1. Early and accurate diagnosis.
2. A nutritionally rich diet.
3. Supplementation of the diet with **BASIC FORMULA VITAMIN TABLETS SQUIBB**
4. Augmentation of the intake of B-Complex factors with dried brewer's yeast, yeast concentrate or oral liver extract.


Reg. U. S. Pat. Off.
30 Coated Tablets
Squibb Basic Formula Vitamin Tablets
See side panel for dose
E. R. SQUIBB & SONS, NEW YORK
Made in U.S.A.

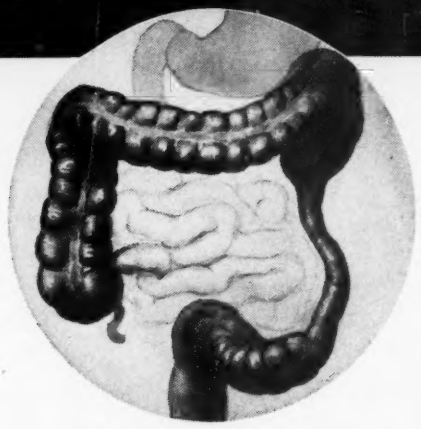
The composition of Basic Formula Vitamin Tablets Squibb is as follows:

**10 mg. Thiamine Hydrochloride**
**5 mg. Riboflavin**
**50 mg. Niacinamide**
**75 mg. Ascorbic Acid**

BASIC FORMULA has a background of proved clinical value—in Birmingham, Alabama, and in New York City. This is the "basic formula" used by Dr. Norman Jolliffe and Dr. Tom D. Spies, and described by the latter in his study on the nutritional rehabilitation of 100 American workers for industry.

Do as many nutrition experts do – use *Basic Formula* in treating deficiencies of water-soluble vitamins. Ample supplies are now available. A recent reduction in price has lowered the cost more than one-third. Remember, Basic Formula Vitamin Tablets Squibb represent the *exact composition* of the "basic formula" many experts have used and recommended. It is best, however, to specify "SQUIBB" in ordering to be sure your patient receives the original effective formula.

**Basic Formula Vitamin Tablets**
**SQUIBB**



# FOR THE CONSTIPATION OF THE AGED...

Old people who eat little and lead quiet, inactive lives tend to become constipated. Restoration and maintenance of "habit time" is of prime importance to the patient's well-being.

Petrogalar gently, persistently, *safely* helps to establish "habit time" for bowel movement. It is evenly disseminated throughout the bowel, effectively penetrating and softening hard, dry feces, resulting in comfortable elimination with no straining . . . no discomfort. Petrogalar to be taken only as directed.

A medicinal specialty of Petrogalar Laboratories, Inc., Division WYETH Incorporated, Philadelphia.

Petrogalar
REG. U.S. PAT. OFF.
Wyeth
REG. U.S. PAT. OFF.
FOR SAFE RETURN TO "HABIT TIME"

# For BASAL Anesthesia

BASAL anesthesia produced by the rectal instillation of a solution of Avertin with Amylene Hydrate generally lasts for two hours or more . . . With a relatively small dose of a supplemental anesthetic satisfactory muscular relaxation may be secured for a prolonged period . . . General anesthesia is usually maintained on a relatively high oxygen intake.

Avertin with Amylene Hydrate is supplied in bottles of 25 cc. and 100 cc., each 1 cc. containing 1 Gm. of Avertin and 0.5 Gm. of amylene hydrate.

Avertin

Trademark Reg. U. S. Pat. Off. & Canada

*Brand of* TRIBROMETHANOL

WITH AMYLENE HYDRATE

ACCEPTED AMERICAN MEDICAL ASSN.

This cherished symbol of distinguished service to our Country waves from the Winthrop flagstaff.

WINTHROP CHEMICAL COMPANY, INC.

*Pharmaceuticals of merit for the physician*

NEW YORK 13, N. Y. WINDSOR, ONT.

## *A step forward in Menopausal Therapy*

Today we accept synthetic estrogens as a rational means of controlling the menopausal patient, forgetting the blind gropings of the therapists of only forty years ago.

The advent of modern endocrinology and biochemistry made possible the combination of the newest synthetic estrogen, hexestrol with the safe, universally accepted sedative, phenobarbital, thus formulating Hexital.

Hexital, in addition to providing more extensive control of symptoms, is effective in greatly reducing the incidence of undesirable side-effects associated with synthetic estrogen therapy. Nausea is practically eliminated by this new stilbestrol derivative, plus a sedative.

Dosage: One tablet containing 3 mg. of hexestrol and 20 mg. of phenobarbital is the average dose, preferably taken at bedtime. It is supplied in bottles of 100 scored tablets.

ORTHO PRODUCTS, INC. LINDEN, NEW JERSEY

# hexital

(HEXESTROL-PHENOBARBITAL)

# The American Journal of Surgery

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# In Post-Tonsillectomy
# GRANULAR PHARYNGITIS

SUBSEQUENT to the removal of infected tonsils, a granular pharyngitis may develop with symptoms of a constant sore throat, a sensation of a foreign body in the throat, or a collection of mucus clumps.

Lillie[1] observes that the best method of treatment on an empirical basis is the ingestion of iodides and suggests one tablet of ethyl diiodobrassidate chewed and swallowed from 2 to 4 times a day for a period of 5 days, decreasing as symptoms ameliorate.

Ethyl diiodobrassidate is available as Lipoiodine* in tablets free from local irritating effects and with a lower incidence of iodism in the usual dosage.

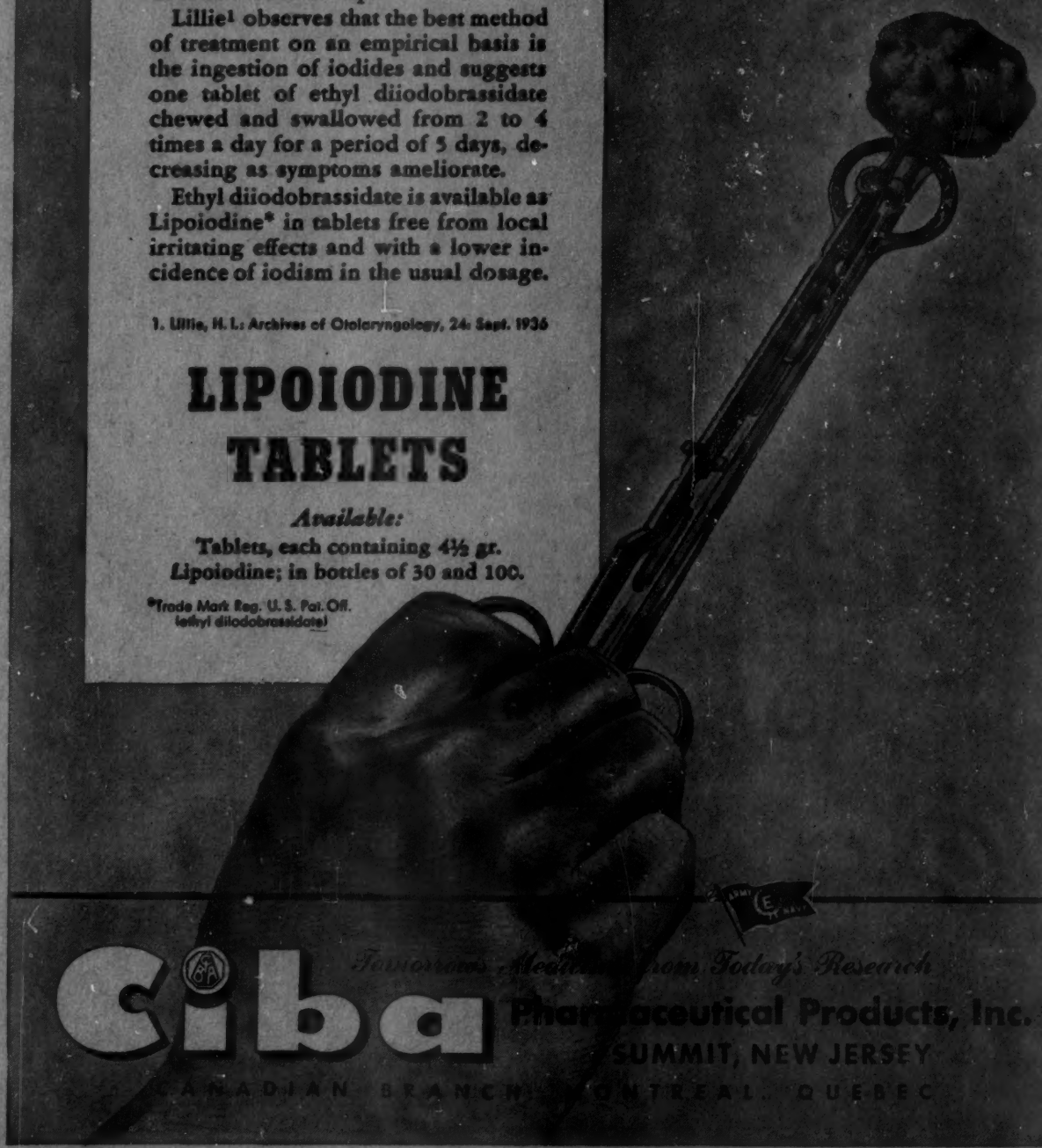
1. Lillie, H. I.: Archives of Otolaryngology, 24: Sept. 1936

## LIPOIODINE TABLETS

*Available:*

Tablets, each containing 4½ gr. Lipoiodine; in bottles of 30 and 100.

*Trade Mark Reg. U. S. Pat. Off. (ethyl diiodobrassidate)



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*Favorable Medicinal Action from Today's Research*

Pharmaceutical Products, Inc.

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